JOURNAL
OF
ECONOMIC ENTOMOLOGY
OFFICIAL ORGAN AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

VOL. 6 JUNE, 1913 No. 3

# Proceedings of the Twenty-fifth Annual Meeting of the American Association of Economic Entomologists

(*Continued from page 257*)

## PRELIMINARY REPORT ON THE PARASITES OF COCCUS HESPERIDUM IN CALIFORNIA [1]

By P. H. TIMBERLAKE, *Bureau of Entomology*

In the early days of citrus fruit culture in California the soft scale (*Coccus hesperidum* Linn.) is said to have been one of the worst of the scale pests, and to have vied with the black scale (*Saissetia oleæ* Bern.) in destructiveness and difficulty of control. At the present time it is little feared by intelligent growers, and in fact plays a rather insignificant rôle in the citrus orchards of southern California. Its present harmlessness is due apparently to its inability to withstand the combined effect of fumigation and the recurrent attack of parasites.

Outside of the fumigation districts the soft scale may be frequently found on cultivated and native shrubbery, yet rarely in large colonies, most often existing in a scattered condition and apparently always under these circumstances being heavily parasitized. As the soft scale, like most Coccidæ, is essentially gregarious in habits, we are led to believe that, whenever it is found scattered by ones or twos over the foliage of its host plant, this condition is due to, and characteristic of, heavy parasitism.

Inasmuch as fumigation appears to be quite as fatal to the parasite as to the host, it is not surprising on the other hand, that the soft scale, when it does break out in a citrus orchard, should increase in an alarming manner for a time and form large clustered colonies on the woody shoots. Such outbreaks do occasionally appear and are

[1] Published by permission of Dr. L. O. Howard, Chief, Bureau of Entomology.

almost invariably confined to the fumigation districts. This condition, we are again led to believe, is brought about or encouraged by the temporary absence of parasites.

Such colonies of the soft scale are more often seen, perhaps, in young orchards on newly broken ground, or even in older orchards where ants are especially numerous. What was probably the worst infestation of the soft scale, that came to notice in the course of two years' study, was located at Riverside, Cal., in the heart of a small tract overrun by the Argentine ant (*Iridomyrmex humilis* Mayr). There is not the least doubt that this and other species of ants eagerly attend the soft scale for the sake of the honey-dew it copiously secretes, and there is reason to believe that they unconsciously or even perhaps militantly protect their provider from the attack of parasites. So far as we are aware, however, this conclusion has never been verified by observation.

The parasites of the soft scale observed in California during the past two years are five in number, and being arranged in order of their probable effectiveness stand as follows: *Aphycus* sp. near *flavus* Howard, *Microterys flavus* (Howard), *Coccophagus lecanii* (Fitch), *Coccophagus lunulatus* Howard, and *Aphycus* n. sp. near *coquilletti* Howard.

The *Microterys*, and sometimes *Aphycus* also, is attacked by no less than eight hyperparasites listed as follows: *Coccophagus lecanii* (Fitch), *Pachyneuron* sp., *Eusemion longipenne* (Ashmead), *Eusemion* n. sp., *Perissopterus javensis* Howard, *Tomocera californica* Howard, *Cheiloneurus* n. sp., and *Cerchysius* sp. The relationship of still another parasite, a new species of *Anicetus*, has not been determined, but it is apparently hyperparasitic.

### *Aphycus* sp. near *flavus* (Howard)

This *Aphycus* is a common and well-distributed parasite of the soft scale in California, and also occasionally attacks small immature specimens of the black scale (*Saissetia oleæ* Bern.).[2] It has been given first place in order of effectiveness because of its more general distribution and its habit of destroying its host in the early stages before any damage has been done or any offspring produced. As a parasite of *Coccus hesperidum* it is partial to the young scales from 1 to 1.5 mm. long, but will attack successfully much larger hosts as long as they are still immature. Old scales that attain a certain degree of convexity are free from further molestation. The smaller hosts are able to support only one parasite, but in the larger ones as many as six or even

[2] The original host record of *A. flavus* given by Howard is undoubtedly incorrect. The peculiar and specialized larval habits preclude the possibility of its being a parasite of *Lepidosaphes beckii* (Newm.) or any other Diaspine scale.

more may mature. This *Aphycus* is able to pass through many generations a year, as it develops from egg to adult in about eighteen days at summer temperature. In many respects its life history is similar to that of *Microterys flavus*, which will be treated more fully.

The other new species of *Aphycus* is extremely rare and has been found only at Carpenteria, near Santa Barbara, and at Avalon, Catalina Island.

*Microterys flavus* (Howard)

*Microterys flavus* (formerly placed in the old genus *Encyrtus*) is the largest and the most interesting of all the parasites of the soft scale found in California. It is likewise effective to no small degree and would have been given first place in the above list were it not for two considerations: first, it does not seem to be able to survive in any abundance wherever fumigation is extensively practised; and, secondly, it is a parasite of gravid or even mature scales, which in many instances leave a few offspring to two or three hundred before succumbing.

This species is found throughout central and southern California, but it is much less abundant in Los Angeles County than it is near San Diego and Santa Barbara, or throughout the central part of the state. Although originally described from California it was perhaps introduced with its host many years ago through commerce. It has been reported also from Ceylon, Ontario and several Eastern States. Other recorded hosts in America are *Lecanium corni* Bouché and *Pulvinaria vitis* (Linn.), but it seems to attack only the soft scale as a rule in California.

This parasite is attacked by all of the hyperparasites that were enumerated above, but its abundance is hardly modified by them as a rule, and only one case has been found where it was apparently not able to hold its own. In cases of superparasitism where there is a struggle for the possession of the host between *Microterys* and some other parasite such as *Aphycus*, the former is generally worsted, probably on account of its specialized larval habits. When the struggle is between *Microterys* and *Coccophagus lunulatus*, the most frequent and probably the invariable outcome is that both succumb. In observed instances the *Microterys* has been starved by lack of sufficient food, as it does not attack the *Coccophagus* larva or pupa, and the latter succumbs because of the premature death of the host. *Coccophagus lecanii* is generally a hyperparasite when it comes into conflict with *Microterys*, but one instance has been observed where it was superparasitic. In this case the *Microterys* larva was overcome while still small, and the *Coccophagus* developed as a primary parasite.

The *Microterys* female is a pretty, little Encyrtine chalcid of deep

brownish yellow color and banded wings. The females may be kept alive for fifty or sixty days by feeding them with glucose and water if not allowed to oviposit. If supplied with suitable hosts for oviposition the life of the female is considerably shortened. A female that was kept constantly provided with hosts died apparently of exhaustion after thirty-two days, although it had a constant and copious supply of acceptable food in the honey-dew excreted by the scales. This female deposited 212 eggs during the thirty-two days, and after its death eleven more perfect or nearly mature eggs were found in the oviduct and lower part of the ovarian tubules. Other females that were perhaps less skillfully handled deposited in about the same number of days 91, 98, 99, 103, 116 and 125 eggs, respectively.

This species of *Microterys* like all other Encyrtines that we have observed will reproduce freely by parthenogenesis, and is always arrhenotokous under such circumstances; in other words, unfertilized eggs always produce males, and fertilized eggs females. The female in ovipositing is deliberate and circumspect and has the same general habits of other chalcidoids. The process of ovipositing generally takes about 1¼ to 2 minutes, the exact time being more or less dependent upon the resistance met in penetrating the derm of the host. Notes were once taken on a female which oviposited seven times in succession in a single host, all within fifteen minutes. The average time taken for the penetration of the host's derm in this case was fifty-one seconds, the actual periods varying between forty and seventy-five seconds. The full period of oviposition in these instances varied from one minute and twenty-five seconds to two minutes and twenty seconds, with an average of one minute and forty-four seconds.

The female even when confined in a small vial shows considerable judgment in the choice of hosts. The most suitable hosts, or at least those generally chosen first, are newly gravid females which have recently become convex or plump. Such hosts after death have a clear, translucent derm which permits the later stages of the parasite to be studied at leisure. Even these scales frequently produce a few offspring before death ensues, but still older ones are sometimes chosen that produce a large number of young. On the other hand, immature scales as small as 1.5 mm. long may be attacked if larger hosts are not to be found. In the small scales rarely more than one egg is deposited, but in larger ones according to their size, two or three even up to six or seven eggs may be normally placed.

Although it is true that the minimum and maximum amount of food that will support one *Microterys* larva allows for considerable latitude, yet the females seem to have a well-developed instinct for judging the number of eggs that may be safely placed in one host without

superparasitism resulting. In other words, superparasitism is comparatively rare, even when the females reproduce under the artificial conditions of confinement. If too many eggs are deposited in one host, one or several of the larvæ may be killed and devoured by the rest. This disposal of the supernumerary larvæ most frequently takes place while they are still in the second stage, if a study of the larval remains may be relied upon. If, on the other hand, too few eggs are deposited in a given host, the development of the parasites may be retarded. One host has come under observation that illustrated especially well this retardation. It was a large, fully matured scale with substance enough to have supported at least three or four *Microterys* larvæ, but for some reason only two eggs had been deposited therein. The larvæ on reaching their maximum size had failed to consume completely the tissues of the host, and before casting their meconium preparatory to pupation they were obliged to wait until the unconsumed tissues had dried up at least to some measure. The development for this reason was retarded about two days.

The ovarian egg of *Microterys* is a peculiar object with two bodies, one more than twice as large as the other connected together by an extraordinarily long, slender stalk. The larger body is the egg proper, within which the embryo later develops, whereas the stalk and smaller body are specialized structures made use of by the larva even nearly to the end of the larval period. After deposition of the egg in the body of the scale the smaller body is left projecting into the outside air through the derm or integument. It has now contracted into a slender white stalk continuous internally with the still slenderer egg-stalk proper. The egg-body by these means is deeply suspended among the tissues of the host. Externally, moreover, each egg is made evident by the white, projecting stalk which is easily visible under a good hand lens. A study of the location of the stalks in many parasitized scales shows that the female oviposits with few exceptions in the mid-dorsal region of the host.

The egg at summer temperature hatches in about seventy hours after deposition. The newly hatched larva does not drop as might be expected from the egg-shell which is split down on one side at eclosion, but remains anchored therein by its anal end. It even thus maintains without the least doubt an intimate and vital connection with the egg-stalk, and the latter might properly be called a living part of the organism. After each of the two larval molts the exuviæ are pushed back but remain attached to the egg-shell, forming thereby a blackish colored funnel within which the larva still remains anchored. As in the first stage of the larva, an intimate relation is kept up with the egg-stalk until the tissues of the host are nearly consumed and the larva

is practically full grown. A study of the deserted funnels in issued hosts reveals the fact that each one of the two component molt-skins has a delicate, slender tube which penetrates the egg-stalk one within the other.

The egg-stalk as here described is strictly homologous and similar to a larval structure of *Schedius kuvanæ* Howard, an Encrytine egg-parasite of the gipsy moth from Japan. The function of this structure has been described as respiratory, as it is thought that the larva thereby obtains its supply of air from the outside world.

The larva molts for the first time about one day after hatching, and again about two days later. It is full grown in about five days or a little over, and on the sixth day after hatching begins to cast its meconium. After still another day it pupates, in all about ten days from the deposition of the egg.

The pupa of *Microterys* shows marked sexual dimorphism not only in the color that is finally assumed, but also in external structure. The fully colored male pupa is black, and the antennal sheaths are bent around the sides of the head in a way suggestive of the handles of an ancient or Grecian amphora. The female pupa is dark brownish yellow in color, and the antennal sheaths are far less conspicuous, being situated more beneath the head. The pupal period lasts about seven days, but the imago does not become active until a few hours to a day later. The entire developmental period from egg to the issuance of the imago is therefore about eighteen days at summer temperature.

### *Coccophagus lecanii* (Fitch)

*Coccophagus lecanii* is a scale parasite of generalized habits and wide distribution. It is common almost everywhere in California, and is a frequent parasite of *Coccus hesperidum*, but when associated with *Microterys* or *Aphycus* it is not rarely hyperparasitic. As a primary parasite it chooses small, immature scales without exception, and brings about some pathological change or condition in the host, whereby the hypodermal tissue of the mid-dorsal region becomes more or less black-pigmented. In the case of other hosts, such as *Saissetia oleæ* (Bern.), *Lecanium corni* Bouché and *Physokermes insignicola* (Craw) the blackening of the derm may not be so apparent. Before pupating the solitary larva consumes the entire tissues of the host.

As a secondary parasite this species of *Coccophagus* undergoes a radical change in its larval habits, and becomes an external feeder. The female places its eggs upon either the full grown larva or pupa of the primary parasite, which in only three or four days' time after the egg hatches is entirely consumed or reduced to a shriveled mass

of integument. The *Coccophagus* larva then proceeds to cast its meconium and pupates within the body of the scale, quite after the manner it has when primary.

*Coccophagus lecanii* like many of the Aphelininæ is normally parthenogenetic in reproduction and regularly thelyotokous, producing females generation after generation without the intervention of the male. A curious phenomenon occurs when this species becomes hyperparasitic, as the offspring has been found to belong to the male sex in all cases so far observed. This change in the sex of the offspring takes place not only under artificial conditions in experiments, but also in the case of hosts parasitized under normal field conditions. The exact factor in this sex determination has not been discovered. It apparently does not inhere in the usually somewhat smaller amount of food, for in some instances the resulting male is fully as large as the normal-sized female.

### *Coccophagus lunulatus* Howard

This species of *Coccophagus* has more specialized habits than the preceding species and is always a primary parasite. It is, moreover, not as common although well distributed in California. It attacks also immature scales of *Lecanium corni* Bouché and *Saissetia oleæ* (Bern.). The original record of its host relationship which states that it was reared from *Chrysomphalus aurantii* (Mask.) is undoubtedly incorrect, as its peculiar life-history practically precludes the possibilty of its being a parasite of any Diaspine scale.* As a parasite of *Coccus hesperidum* it is partial to scales that are about half-grown or larger, but it very rarely if ever attacks those that have become mature. As many as two or three larvæ may successfully develop in the larger hosts.

Unlike *Coccophagus lecanii* this species never blackens the hypodermal tissue of the host although the black-colored pupa lying just beneath the translucent derm, may temporarily cause a blackened appearance. *C. lunulatus* also differs markedly from *lecanii* in always avoiding the vital organs of the host, and in pupating *in situ* before the host has been entirely consumed and killed. The pupæ, in fact, are always found in the still living host, which often survives until after the issuance of the adult. This remarkable habit of the parasite is made possible through the fact that it pupates within the last larval exuvia, which becomes filled with air and acts as a protecting shroud. The meconial discharge, moreover, is not voided at random among

* See Howard, L. O., Insect Life, vol. 6, p. 232, 1894, and Quayle, H. J., Bul. 222, Cal. Agr. Exp. Station, p. 136, 1911.

the tissues of the host, but is wadded up into one or several masses, which may be found during the whole life of the pupa closely appressed to the tip of the abdomen.

Although the host is frequently still living and filled with moist or even watery tissues when the *Coccophagus* is ready to issue, yet the latter easily escapes, and is ready to fly away almost the moment it emerges through the exit-hole. This fact is accomplished the more readily inasmuch as the imprisoned pupa lies always closely pressed to the dorsal derm of the host, with the soft tissues pushed to one side, and since the newly transformed imago is always completely enshrouded in the larval exuvia until it gnaws its way out into the open air. These larval and pupal habits of *lunulatus* are evidently adaptive specializations to prevent the occurrence of desiccation, since the pupæ most frequently die if the host is removed from the twig and allowed to dry up.

*Coccophagus lunulatus* was described from California, and is not yet known to occur elsewhere. Its specialized habits for living in a semi-arid climate point to California as its native home.

## The Hyperparasites of the Soft Scale

Of the hyperparasites mentioned above, we have already spoken of one, *Coccophagus lecanii*, which is usually and essentially a primary parasite. This is true also of *Tomocera californica*, ordinarily a parasite of the black scale, and once only reared as a secondary of *Microterys flavus*. This unique record must be considered more as an indication of the versatility of this species than of anything else. *Perissopterus javensis* has been reared as a parasite of *Microterys flavus* and *Coccophagus lecanii*. It may be therefore a tertiary parasite at times and one individual has been recently reared which was actually of this class, having attacked a *Coccophagus* that in turn had destroyed the larva of *Microterys*. It is probably never a primary parasite in connection with the soft scale, and its value as a parasite of the other recorded hosts is open to doubt. This *Perissopterus* was described by Dr. Howard from Java, and its occurrence in California is noteworthy. As it has been found only at Sacramento, near the State Insectary, it has been presumably introduced. The *Pachyneuron* sp. was reared only on one occasion and is not at all common in connection with the soft scale. Its larva like that of *Perissopterus* is an external feeder.

The remaining hyperparasites are all Encyrtines of the tribe Mirini, and all are obligatory in this role of parasitism. They are in connection with the soft scale internal parasites of *Microterys* or sometimes *Aphycus*, other members of the same subfamily and tribe. In this group of hyperparasites *par excellence* fall the two species of *Eusemion*,

one undescribed, the other *E. longipenne*, *Cheiloneurus* sp. and *Cerchysius* sp. The undescribed species of *Anicetus* is most probably a fifth species of this group, and has been found only at Sacramento.

*Cerchysius* sp.

Of these species the *Cerchysius* is by far the most common, although in another connection as a parasite of *Scutellista cyanea* and *Tomocera californica* underneath the black scale (*Saissetia oleæ* Bern.). Although it is nowhere abundant, it is rather frequently found under the black scale near Santa Barbara and San Diego. In Los Angeles County it has been rarely found in the last two years. Its presence is at once made known by the characteristic puparium-like shell, which it transforms out of the larval skin of its host, toward the end of its own larval life. As a parasite of *Microterys flavus* on the soft scale it is extremely rare, and has been found only twice, once at San Diego, and once at Santa Barbara. In confinement, however, it reproduces freely on the larvæ of *Microterys*. It is the only one of the Encyrtine parasites of the soft scale that so far has been found to present a distinct tendency toward hibernation.

The undescribed *Eusemion* and the *Cheiloneurus* are both rare and are native species that presumably more or less by chance attack *Microterys flavus* occasionally. Other species of *Cheiloneurus* of which there are many are probably similar in habits, although recorded as primary parasites of various Coccid genera, such as *Lecanium*, *Kermes* and *Pseudococcus*. One or two undescribed species have been reared from Coccinellid larvæ in which connection they may be hyperparasitic on *Homalotylus*. The life history of the present species is nearly identical with that of *Eusemion longipenne*, which will be treated in some detail. The habits of the other *Eusemion* have not been yet fully studied.

*Eusemion longipenne* (Ashmead)

This species was described by Ashmead from Florida, and his single specimen was reared from *Lecanium* on oak. In California the species has been found at Santa Barbara and the neighboring town of Carpenteria, and has been reared in small numbers from collected material as a parasite of *Microterys flavus*. In captivity, however, it reproduces with facility also on *Aphycus flavus*.

The female is a most industrious worker and spends hour after hour in puncturing the scales and in depositing her eggs. She is apparently unable to determine by means of any tactile or other sense residing in her antennæ, whether a scale contains a primary larva or not, for if supplied with unparasitized material she spends many hours

in examining the scales at first with her antennæ and finally with the ovipositor used as a probe. The latter is therefore not merely an instrument for depositing eggs but is also used in the preliminary process of ascertaining the presence and position of the primary larva within the body of the host. If no larva is present the female withdraws the ovipositor presumably without depositing any eggs, or at least if eggs are placed in the body of an unparasitized scale they fail to develop. If, on the other hand, the female detects in the course of the probing movements of the ovipositor the larva of *Microterys* or *Aphycus* she forthwith places an egg within its body. She also oviposits in full grown larvæ and fresh pupæ after the host scale has been reduced to a mere shell of integument. The primary larva moreover is never under any circumstances killed by the *Eusemion*, until it has completed its own growth and has voided the meconial discharge.

The egg of *Eusemion longipenne* belongs to an entirely distinct type from that of *Microterys* or *Aphycus* and is deposited free within the body of the primary larva or pupa. It is decidedly minute and has only a short pedicel, which is functionless after maturation and finally shrivels away. The egg grows or increases in size with the development of the embryo, so that the newly hatched larva is many times the size of the freshly deposited egg.

The larva is rather distinctive in the three larval stages so that the latter may be readily distinguished. The first stage is characterized by a rather conspicuous tail-appendage, but the head is not developed as in the big-mandibled, tailed larvæ of certain Braconidæ. The tail-appendage persists in the secondary stage although it is much shorter, and the third stage is destitute of any such specialized structure. The larvæ, of course, live free within the body of the host, and their exact position may vary, as they have been found while still small either in the head or the abdomen of the pupa. Two or three may develop for a time within one host, but only one survives. On completing its growth the larva entirely consumes the host except the integument and finally makes its escape from the filmy remains. It then proceeds to cast its meconium and complete its transformations within the body cavity of the scale. The entire development from the egg to the issuance of the adult takes place in seventeen or eighteen days at summer temperature. The adult female has been kept alive in captivity for twenty-eight days when allowed to oviposit and as long as seventy-nine days when not supplied with hosts.

## Source of the Parasites of the Soft Scale in California

The source of the soft-scale parasites is of some interest in connection with the long-continued efforts of the State Commission of Horti-

culture in introducing promising parasites and predaceous enemies of scale insects into California. The little that has been said already under the treatment of the individual species indicates that the parasites of the soft scale are either native species of California, or have been introduced accidentally through commerce. The two species of *Aphycus* so far as known are native of the United States, although inasmuch as the species near *flavus* confines its attack mainly to the soft scale it may have been brought with its host into California. The same may be said of *Microterys flavus*, and unless these two parasites have changed their host relationship to a marked degree since the introduction of the soft scale, the probability of their accidental introduction is great. The two species of *Coccophagus* are probably native of California, and *lecanii* is known from many other parts of America.

Leaving out of account those species which are essentially primary in habits, viz.: *Coccophagus lecanii* and *Tomocera californica*, all the hyperparasites except *Perissopterus javensis* are undoubtedly native species and will presumably be found attacking the parasites of native Coccids when these have been studied thoroughly.

### Predaceous Enemies of the Soft Scale

This account of the natural control of the soft scale would not be complete without some mention of its predatory enemies. Considering that the soft scale is such a defenceless creature, we should naturally expect that its predaceous enemies would abound. This, however, does not seem to be the case and in fact only one predator has been noticed actually feeding on the scales. This is the common *Rhizobius ventralis* Er. introduced into California many years ago. It is abundant in southern California, being often found feeding on the black scale, but it is rarely associated with *Coccus hesperidum*.

---

## PRELIMINARY REPORT ON THE PICUDO OF COTTON IN PERU

By Charles H. T. Townsend, *Lima, Peru*

### Origin, Discovery and Occurrence

The Peruvian cotton square-weevil, *Anthonomus vestitus*, now commonly known in Peru as the *picudo del hielo*, is evidently a native of South America and originally invaded the semi-arid Peruvian coast region, probably centuries ago, from the humid tropical districts bordering the Gulf of Guayaquil. It was originally described by Boheman from the Island of Puná in the Gulf of Guayaquil, and has recently

been carefully redescribed by Mr. W. Dwight Pierce, of the Cotton Boll-weevil Laboratory in Texas.

This weevil was rediscovered by the writer, September 21, 1910, at Cumbibira in the Piura valley, a little below Catacaos, where it was found to be a pest of cotton, breeding and feeding in the buds of the squares. The same year it was found infesting cotton throughout the main districts of the Piura and Chira valleys, and it was later found to be entirely confined to the cotton plant. The above was the first recovery of the species after Boheman's description of it, yet it had doubtless been breeding continuously in the cotton district of the Peruvian coast region ever since and for many years prior to Boheman's publication. The results of its work were conspicuous in the cotton fields during all these years and received the name of "hielo," yet the presence of the weevil itself as the definite cause of these results remained unknown until 1910. The term "hielo" was originally applied to the yellowed and withered squares and newly-set bolls, but has since been incorrectly extended to include dropping and defective ripening or premature to retraded opening and decay of the large bolls, due probably both to Dysdercus attacks and to an undue degree of soil-moisture during the ripening season. It is thus applied quite indiscriminately in Peru at present, but it may be stated here that practically all "hielo" of squares and newly-set bolls is the result of the work of *A. vestitus*, either in feeding or in oviposition and breeding.

In 1911 the presence of the weevil in cotton squares in the Guayaquil district of Ecuador was demonstrated, and it was also found to occur far to the south, in the Chancay valley a little north of Lima. During 1912 it was found abundant in April in the Casma valley, which is just north of the Chancay districts; in some number in July at Lima; in a very few specimens in July above Chosica, the locality being in the Rimac valley at about 3,000 feet; and in numbers in June at Tambo de Mora, which is just north of Pisco. It is thus quite evident that this weevil exists as a cotton plague throughout the Ecuadorian and Peruvian coast regions.

## Response to Climatic Conditions

Probably the most highly instructive region in the world for the study of cotton weevil bionomics is comprised in this known range of *A. vestitus*. The cotton districts of the coast and foothill region from Guayaquil southward to Pisco and Ica present every variety of climate above the frost-point temperature that is possible of attainment where the cotton plant may be supported in bearing condition. For example, the localities Guayaquil, Piura, Lima, Chosica,

Ica and the foothill valleys represent six very distinct and conspicuously contrasted sets of climatic conditions.

Guayaquil is hot-humid throughout the year, with heavy tropical rains.

Piura is hot-arid from December to May, and cool-subhumid during nights and mornings from June to November; practically without rain, at most with irregular slight sprinkles or showers during the warm season which very exceptionally become heavy rains known only at long intervals.

Lima is hot-subhumid to dilute subarid from December to May, and cool-humid with continuous cloud-blanket and almost daily drizzling mist from June to November; practically never with heavy rains, and very exceptionally with slight sprinkles or showers in the warm season.

Chosica is hot-arid with a very low relative humidity from December to May, and bracing cool-arid from June to November; with continual clear sky practically throughout the year.

Ica is hot-arid from December to May, hot-arid during days and cool-subhumid during nights from June to November; without rain, drizzle or mist, but with some cloudy weather in the afternoons during August to October, aside from which the sky is practically clear during the day throughout the year.

All of the above localities are practically but little above sea level, except Chosica which is 2,800 feet. Just a little farther back in the foothills from Chosica and a little higher up lies a region of valleys which are hot-humid from December to May with considerable rain fall, and cool-arid from June to November with clear sky. The climate of the Ica cotton districts is markedly distinct in character from that of all the immediately surrounding districts, due to wide rainless deserts on both sides of the valley, and approaches that of Piura to such an extent that it is only in the Piura and Ica districts that the native tree-cotton or pais variety can be profitably grown. Ica is just nine degrees farther from the equator than Piura and its nights during the cool season are colder, but on the other hand it has less atmospheric humidity during the cool season than Piura.

The weevil is quite certainly active at practically all times of the year in the humid tropical Guayaquil district. It is known to be practically inactive in the Piura region from December to May, which season is truly arid in this region; and very active from June to November, which months show considerable atmospheric humidity. It was known to be very active in March and April in the Casma region in 1912, during a period of considerable atmospheric humidity. It seems quite certain that it is more active during the warm season in

the central coast region, as from Casma to Lima, than during the rest of the year. It was found at Lima to be only moderately active during July. The season from June to November in the Lima region seems cool enough to interfere to a considerable extent with the weevil's activity, at least to the extent of retarding its development considerably. The Lima temperature ranged during July, 1912, from 55° to 68° Fahrenheit, or 13° to 20° Centigrade; while the humidity hovered around the saturation-point most of the time. The rest of the year does not show sufficient aridity to check the activity of the weevil, while the much higher temperature accelerates its development. The warm season of 1912 was unusually humid in the Casma to Lima region, and it is therefore certain that the weevil was more than ordinarily active there at that time; but it is equally certain that it remains active through the hot season to a considerable extent in the central coast region, while in Piura the excessive aridity cuts short its activity.

Chosica is colder at night and warmer during the day in the cool season than Lima. Its temperature ranged during July, 1912, from 45° to 79° Fahrenheit, or 7° to 26° Centigrade; the relative humidity is very low throughout the year. The weevil was found at the very lowest ebb of activity in July, 1912, just above Chosica, only one adult being found in a green square during two hours' search. It is quite certain that it is somewhat more active in the Chosica region during the warm season, but not enough so to cause any material damage. The Chosica climate can not be termed even subhumid at any time of the year, though the relative humidity is slightly higher during the warm season.

The weevil is not yet investigated in the Ica districts, but it is practically certain that it exists there to a somewhat greater extent than at Chosica. It was found abundant and active at Tambo de Mora during May and June, 1912. Temperature at Ica during July, 1912, ranged from 45° to 73° Fahrenheit, or 7° to 23° Centigrade. Its nights during the cool season are thus about the same as those at Chosica, while its days are not so warm. It is arid like Chosica for most of the year, except for considerable relative humidity at night only from June or July to November and some slight cloudiness in the day from August to October. This climate must allow the weevil at least two or three months of activity during the year, but it is probably not so highly active here at the best as during the more pronounced subhumid season in Piura. It is worthy of note that, while the weevil is probably the least active in the Chosica and Ica districts, its maximum of activity in these two districts comes at opposite seasons of the year.

In the San Bartolomé to Matucana districts and others just a little farther back into the foothill region from Chosica and higher up, where the warm season changes to humid while the cool season remains arid, the weevil should be decidedly active from December to May, much more so than at Chosica. Matucana is 7,800 feet altitude, yet its temperature during July, 1912, ranged from 45° to 77° Fahrenheit, or 7° to 25° Centigrade. Its nights are therefore practically the same during the cool season as those at Chosica and Ica, while its days at the same season are slightly warmer than the Ica days and slightly cooler than the Chosica days. So far as the climate goes, certain varieties of cotton would undoubtedly produce well as high up as Matucana, but the weevil would quite certainly be able to maintain itself there and would cause much damage to the crop during the warm growing season.

The above data are sufficient to show the remarkably complex character of the more or less arid coast to foothill climate of Peru, which exhibits numerous gradations of aridity and humidity with opposites often contrasted in juxtaposition. A comparative study of the weevil in these various districts will not only throw full light on the bionomics of cotton weevils in general, but will indicate those districts of the Peruvian coast and foothills where cotton may be cultivated with little or no danger of injury by the weevil.

It is important to point out here the factors which give rise to this climate with its variations. The tradewinds sweeping southwest across the Atlantic gather moisture to saturation in their course, which they gradually yield up as they cross the Brazils and ascend the eastern slope of the Andes. Their last particle of moisture is extracted by the snow and ice crests of the Andes, so that when they pass high over the Peruvian coast region they are perfectly dry. The wide Humboldt ocean current from the Antarctic region hugs the whole coast of Peru and its waters are about seven degrees Centigrade colder than the superincumbent layers of the air. The winds which blow from the south over this cold ocean current have their moisture largely extracted by it before they can cross it while their temperature is at the same time much lowered; thus when they strike the much warmer littoral precipitation is impossible, and it is only when they arrive far enough inland and high enough up to encounter soil temperatures equal to or colder than their own that precipitation of their residue of moisture takes place. The distance inland and the altitude for this precipitation vary with the season of the year. These data furnish a basis for more or less exact calculations indicating the climatic variations peculiar to the different districts at different seasons.

## Parasites and Predaceous Enemies

In Piura the following hymenopterous parasites are at work on the weevil during the subhumid season:

*Triaspis vestiticida*—Well distributed and most abundant of all the enemies of the weevil in the Chira and Piura valleys. This species alone kills over 12 per cent of the weevil in Piura, while all the other parasites together only raise the percentage of weevils killed by parasites to short of 17 per cent.

*Microbracon vestiticida*—More or less distributed in both valleys, and more numerous than any of the remaining parasites but less than one sixth as numerous as the preceding.

*Cerambycobius townsendi*—Sparingly distributed in both valleys, and only a little more than half as numerous as the preceding species.

*Cerambycobius peruvianus*—Very rare. Chira valley.

*Catolaccus townsendi*—Small numbers in both valleys, but principally in the Piura valley.

*Eurytoma piuræ*—Still smaller numbers than preceding, in both valleys.

The determinations of the above are by Mr. J. C. Crawford (Chalcidoidea) and Mr. H. L. Viereck (Ichneumonoidea).

The following species of hymenopterous parasites have been reared from lots of weevil-infested squares and bolls from the Piura region, and while the probabilities are that they are parasites of the weevil they are not yet positively known as such:

*Microbracon* sp.—One from each valley.

*Cantharoctonus stramineus*—New genus and species. Two from lower Chira valley.

*Daictimorpha peruviana*—New genus and species. Three from the Piura valley at Catacaos.

*Encytinæ*—An undescribed new genus and species. One from each valley.

*Rogas* sp.—Three from three separated points in the Piura valley, and two from the Chira.

*Pseudapanteles* sp.—One from lower Piura valley

*Chelonella townsendi*—Four from the middle Chira valley.

Determinations are by Messrs. Crawford and Viereck.

From several lots totaling less than 400 infested squares collected in the upper and lower Casma valley, April 1 to 7, 1912, there were secured 455 weevils and not a single parasite. This seems very strange. It certainly indicates that parasites of the weevil were practically inactive, if present at all, in the Casma valley during the first week of April, 1912, while the weevil was highly active. As parasites of the weevil are known from the Lima region, it seems hardly possible

that they can be absent from the Casma valley. It appears more likely that the abnormally humid hot season of 1912 in the central coast region was unfavorable to the parasites of the weevil, but not so to the weevil itself.

On July 9, 1912, 143 yellowed and withered squares were collected at Santa Beatriz, near Lima, from which were secured thirty-nine weevils, nine known parasites of the weevil and five doubtful parasites. The fourteen parasites secured from this lot are as follows:—

*Catolaccus* sp. probably *C. townsendi*—Two females and five males agreeing with this species in color.

*Microbracon* sp. near *M. vestiticida*—Two males. Differs from this species in the disposition of black; but may be only a variety.

*Braconid* sp.—One. Doubtfully parasitic on the weevil.

*Braconid* sp.—Three males; and one female that seems to belong with them, but differs in coloration. Rather small for parasites of the weevil.

In Texas a small black stinging ant, *Solenopsis geminata*, is well known as a very effective enemy of the boll-weevil, often killing 25 or 30 per cent of the early stages in the fallen squares. This species exists in the western foothills of the Andes, and it is almost certain that it would destroy the early stages of the picudo in Peru as effectively as it does those of the boll-weevil in Texas. A closely allied ant, doubtfully determined as *Solenopsis pylades* by Dr. Wheeler, occurs commonly in the Piura cotton-fields where it is known as *hormiga picador*, but it has not as yet been observed to prey upon the weevil. Colonies of *S. geminata* should be transferred from the Andean foothills to the cotton districts of the coast region, and established there.

In Guatemala an ant known as the kelép, *Ectatomma tuberculatum*, is known as a very effective enemy of the adult boll-weevils, which it seeks and attacks in the green squares while they are engaged in feeding and ovipositing. This species exists in the eastern foothills of the Andes, being known to range from Guatemala south through Costa Rica and the Andean montanya to the valley of the Rio Beni in Bolivia. Colonies of it should be transferred from the montanya to the cotton districts of the coast region, and there established if possible. Its introduction was attempted in Texas, but the conditions there were unfavorable to it. The conditions in the Peruvian coast region would probably prove much more favorable to the kelép than those of Texas.

## Cultural Control Measures

The carrying out of a carefully planned series of experiments is urgently needed to demonstrate the details of cultural control measures

against the weevil that will be adapted to the very different sets of conditions existing in the various cotton districts of the coast region. The variety of conditions that obtain in the different districts has already been dwelt upon, and it is evident that specific recommendations must be made for each set of conditions. The following general lines of cultural control work should be tried out under varying conditions, with different varieties of the cotton plant:—

(1) Plant the cotton far enough apart so that the sun may strike the ground between the plants during the more humid season of the year, at this time keeping the fields clean of weeds and grass and pruning out enough of the branches in large plants to prevent shading of the ground. This will allow the hot sun to dry up the fallen squares containing the early stages of the weevil, thus killing the latter.

(2) Irrigate during the dry season and allow as much shading of the ground by the plants and weeds as possible during that season, in order to increase the humidity in the fields. While the result will be a certain amount of increased activity on the part of the weevil, what is more important the parasites and enemies of the weevil will remain largely active through the dry season and in that case will probably gain on the weevil from year to year until they dominate it. The parasites appear to develop in a somewhat shorter time than does the weevil, and it is probable that they do not persist through the dry season as readily nor in as large proportion as does the weevil. It seems thus indicated that they largely lose in the dry season the ground gained during the humid season, which would explain their present inability to catch up with the weevil in point of numbers. This applies to districts like Piura Department which have a pronounced dry season. Rearing experiments covering the Piura and Chira cotton districts have shown that the parasites and weevils to develop in the squares and newly-set bolls during July and August at the rate of one parasite to about five weevils. As these parasites are all native species and have undoubtedly been at work on the weevil in Piura Department for very many years, perhaps centuries, it is clear that they will never catch up with the weevil there under present conditions. It is very probable, however, that they may be aided to the point of greatly increasing their efficiency.

(3) Cut the cotton plants back every year, or replant every year, the replanting or cutting back to be done as nearly as possible at such season as to bring the bulk of the production of green squares on the plants at the dryest season of the year. This may perhaps be done in certain districts with some varieties of cotton. In those districts having a very dry season it would prevent damage by the weevil by allowing the buds and flowers to form while the weevil is

quiescent or inactive. The crop would have to ripen and be gathered in the more humid season, and this fact would make the measure impracticable in many districts. In any event this measure can only be combined with the first above described, and not with the second.

With regard to the fostering of the parasites, as outlined in the second measure above, it should be noted that the only data at present available indicate the possibility of the proportion of parasites falling off later in the season from that above given. From lots collected September 18 to October 11, 1912, by my assistant, Mr. E. W. Rust, at one point, San Jacinto, in the lower Chira valley, there were secured only one parasite to more than 50 weevils, the figures being 38 parasites to 1,998 weevils. The July and August, 1911, lots were from the whole region, and showed 590 parasites to 2,978 weevils. One locality can not show the average for the whole region; and moreover 1912 can not be taken as an index to 1911, for the conditions were different in the two years. The data show the need, however, for an exhaustive investigation of the proportion of parasites to weevils throughout the year, and the range of activity in temperature and relative humidity of the weevil and each of its parasites.

## Longevity and Period of Inactivity

Adult weevils were kept alive for thirty-two days in Lima during July and August, 1912, without light or food, in a small closed pill-box, indoors, at a temperature of 64° to 66° Fahrenheit and during outside conditions of high relative humidity.

Mr. Rust noted in Piura during September and October, 1912, that thirty-three to forty-five days after collection of infested squares, while practically all adults of the weevil that had issued were dead, nearly all to a large proportion of the larvæ still left in the squares were alive. The relative humidity is markedly less during September and October in Piura than during July and August, which explains this larval retardation, the squares having been noted to dry rapidly during this season while in July and August they remained comparatively moist. It appears probable from this that the weevil lasts through the dry season largely in the larval stage as well as in the pupal and adult conditions. As the dryness increases from September to December, retardation of development in all stages becomes more and more marked until inactivity is reached, the return of relative humidity in Piura in May and June awakening the weevil to renewed activity. In all districts activity is lessened by a lowering of the relative humidity.

This period of inactivity, induced in both the square-weevil and the boll-weevil by atmospheric aridity, enables these insects to be

transported long distances and to establish themselves in new districts which furnish sufficient humidity coincident with food-supply during any considerable portion of the year.

## Capacity for Damage

The capacity of the weevil for damage to the cotton crop is not so great in the Peruvian coast region as it would be in a tropical region that is truly humid throughout the year. But its damage varies considerably within this region, according to a variety of factors. Other things being equal, its damage in the various districts is directly proportionate to the annual duration of sufficient relative humidity to maintain its activity. It does the most damage in those districts where the bulk of the squares are formed during the most humid season of the year, providing that the temperature is sufficiently high during that season to accelerate rather than retard its development. From these facts it is evident that the damage is high in Piura, and probably still higher in the central coast region of Peru. Its average damage for the whole coast region must be considerably less than that of the boll-weevil in the more humid region of the southern United States, but it can hardly fall below 20 per cent. This means an annual loss to Peru from the weevil of about £400,000.

## Work for the Future

Future work should consist of fostering the parasites of the weevil so far as practicable in the different districts; introducing and establishing one or both of the two species of ants above mentioned, *Solenopsis geminata* and *Ectatomma tuberculatum*, for attacking the early stages and adults of the weevil respectively, first ascertaining whether these two species are incompatible with each other or whether they may be maintained side by side in harmony, in the former case selecting the more effective of the two; and working out the details of the cultural control measures already outlined.

In order to carry these lines of work through intelligently, full data are needed on humidity and temperature ranges of the weevil and its enemies; and on both cotton varieties and cultural and irrigation methods adapted to the soils and climatic conditions of the different districts in the coast region. Such data can only be obtained by executing well-planned series of experiments in the laboratory and insectary in intimate connection with control work in the field.

# UNSPOTTED TENTIFORM LEAF MINER OF THE APPLE

## (*Ornix geminatella* Pack.)

By LEONARD HASEMAN, *Department of Entomology, University of Missouri*

The unspotted tentiform leaf miner of the apple has been exceedingly abundant for the past two or three years throughout the apple sections of Missouri. It has been gradually increasing in numbers for three or four years and probably reached a climax the past summer in this vicinity. In the orchard here on the horticultural grounds it has been so abundant that during the months of September and October it was almost impossible to find a single full grown apple leaf which did not have from one to twenty mines. Fortunately this type of leaf miner becomes most numerous from the middle to the latter part of the summer and therefore is not as destructive as it would be should its heavy work come earlier in the season.

The unspotted tentiform leaf miner has been known to science for many years, having been first imperfectly described by Packard in his "Guide to the Study of Insects" in 1869. Since that time a number of other names have seemingly been applied to the same species where it has been bred from the foliage of trees other than apple.

*Life Cycle*—For the past two years the writer has been studying this pest in its relation to horticulture in Missouri. In this study a number of interesting points have been determined with reference to its life cycle and habits. The pest in this vicinity invariably passes the winter in the pupal stage protected by a rather firm cocoon which is made somewhere along the edge of a leaf late in the fall. After the first heavy frosts come the leaves containing the cocoons and pupæ fall to the ground where they remain throughout the winter.

The past spring the first moths began to emerge in the insectary on April 17 and on May 3 they were fairly abundant in the orchard. From early May until late November either the adults or the caterpillars in the mines were found abundant here in the orchards. The life cycle is completed in from four to five weeks and five fairly distinct broods were made out in this latitude the past summer. The first brood completed its cycle early in June and about the same date each month following until October succeeding broods were to be found. The broods overlap considerably so that the pest does not have sharply defined generations but the periods at which the first appearance of the heavy attack of succeeding generations is noted may be rather sharply made out.

The parent moths are never very active though after they have emerged a day or two they are seen to fly about in breeding cages and in the orchard during the evening. When at rest the moth takes the characteristic position of other closely related moths, namely, standing with the tip of the wings and the end of the abdomen touching the object on which it rests and with the front part of the body propped up on the two front pairs of legs at an angle of 45°.

The eggs seem to be deposited during the evening and night and are placed singly on the lower side of the leaves. The egg is slightly oval in outline and exceedingly small, from .25 mm. to .4 mm. in length. The shell is beautifully sculptured both on the upper and lower side. This sculpturing is uniform over the entire surface and is so delicate that it requires very high magnification to bring it out. The sculpturing on the lower half of the shell is partially obliterated by the cementing substance which attaches it to the leaf. The writer has not succeeded in locating fresh eggs but from the appearance of the freshly hatched eggs, they seem to be quite flat.

Upon hatching the young caterpillar bores at once beneath the epidermis of the leaf. Not infrequently this tunnel is made through the lower shell of the egg.

For the first few days the caterpillar produces a serpentine type of mine which, to begin with, is not readily distinguished. After three or four days the caterpillar ceases to advance farther under the epidermis of the leaf and begins to eat out the cells on either side of the narrow serpentine mine, thereby producing a distinct blotch mine, and in three to four days more the blotch mine begins to take on the tentiform shape due to the drying out of the lower side of the leaf and to the tension produced by silk spun inside the mine by the caterpillar. The larva, therefore, in its development begins with a serpentine mine and ends with the characteristic elevated tentiform mine. After the tentiform mine is once produced the caterpillar feeds for a number of days upon the layer of chlorophyll cells immediately under the upper epidermis which causes the mine to take on a more or less transparent appearance when all of the chlorophyll has been removed. The mine is completed in from eight to fourteen days. The young caterpillar leaves a trail of fine excrement along the course of the serpentine mine and scatters it promiscuously throughout the blotch mine but in the tentiform mine it is largely collected in one end and may be partly covered with silk.

After the mine has been completed the caterpillar usually continues to inhabit it for a few days after which a small round hole is eaten through the lower side of the mine and the larva crawls about on the foliage and on the limbs of the trees in search of a suitable place to

pupate. Not infrequently it has been found to fold over the edge of the leaf and feed to a slight extent in a new place, though such cases are rare. The caterpillar on preparing to pupate draws over a portion of the edge of a leaf or folds over the edges at the tip of the leaf by means of silk threads and after lining this with silk it pupates, coming out a week to ten days later as the moth. It is interesting to watch the caterpillar tugging away at the silk threads as they are being attached and to see it tie these into bundles so as to shorten them and thereby draw down the edge of the leaf. There would seem to be quite a period between the appearance of the moths and the time at which the first eggs are deposited.

In the development of the caterpillar it passes through four larval stages. In the first stage it is footless, snow white except for a slight tinge of yellow on the head, and somewhat resembling a minute flat-headed borer. In this stage the larva makes the serpentine mine and in it changes to the second larval stage. This is also footless and white except for the head which becomes brownish and the first thoracic segment begins to take on a dorsal black blotch. While in this stage the mine is transformed into a blotch mine. With the change to the third larval stage, which occurs in the blotch mine, the head becomes darker, the thoracic blotch begins to take on the appearance of four irregular blotches and the six thoracic and eight abdominal legs appear. In this stage the larva increases in size rapidly and the body becomes darker. It is usually during this stage that the blotch mine is transformed into the characteristic tentiform mine. The change to the fourth larval stage takes place in the tentiform mine and usually before much of the chlorophyll layer of cells is consumed. In this stage the caterpillar has a brownish head with four dorsal black spots and four similar ones on the first thoracic segment and the body is dark grey with regular rows of white tubercles bearing prominent hairs. After feeding in the mine until mature the larva leaves it and prepares to pupate.

The unspotted tentiform leaf miner will probably never prove to be an exceedingly important pest of the orchard. One can hardly conceive of its ever becoming more abundant than it has been in the orchards of Missouri for the past two years and there is little sign of its having seriously injured either the trees or the apple crop the past summer. In case it does require special attention it can be checked by early spring plowing for the destruction of the leaves containing the wintering pupæ. Spraying has been carried on in the orchards here and has not had the least effect upon the development of the insect, due to the fact that the caterpillar is never ex-

posed to the poison upon the foliage except in those cases where it may feed to a slight extent after leaving the old mine.

In connection with the study of the development and habits of the miner, the writer has had an opportunity of noting the effective work of parasites. During the summer and fall various hymenopterous parasites were exceedingly abundant, so numerous in fact that only a very small percentage of each brood of miners succeeded in maturing. The majority of the miners are killed by small parasites when the mine is yet in the blotch stage, while many more are destroyed by other species of parasites after the mine takes on the mature condition. With the help of these various species of parasites there will probably never be any occasion for fruit growers to fear this miner. The various species of parasites reared from the mines of this caterpillar are now being studied by Prof. C. R. Crosby.

## A NOTE ON TWO ELM LEAF APHIDES[1]

By EDITH M. PATCH

During the past few weeks several items concerning Elm leaf aphides which have come to my notice have interested me enough so that I venture to present them here, not as a formal paper, but merely to call attention to the fact that two perfectly distinct and easily distinguishable species causing elm leaf curl are present in the United States.

One of these migrates to *Pyrus* and *Cratægus* where it is known as the woolly aphid of the apple and that this species extends from the Atlantic to the Pacific coast nurserymen and apple growers almost everywhere can testify to their sorrow.

A second elm leaf species, which is present in California and elsewhere in the Pacific states, appears to be identical with a species recorded from England, Germany, Sweden, and elsewhere which has been ascertained by European workers to migrate from *Ulmus* to *Ribes* and is at present known as *ulmi* (*fodiens*) of Europe.

These two species can readily be distinguished by their antennæ. The *Ulmus-Ribes* species is characterized both in the spring and fall migrants by having joints V and VI without annular sensoria and the terminal sensorium of V is circular and fringed; the terminal sensorium of VI though somewhat irregular in shape being also fringed. The *Ulmus-Pyrus* species has typically annular sensoria on both V and VI in the fall migrant and on V in the spring migrant, while in both forms the circular sensorium of V is lacking, the terminal sensorium being

[1]Papers from the Maine Agricultural Experiment Station: Entomology No. 60.

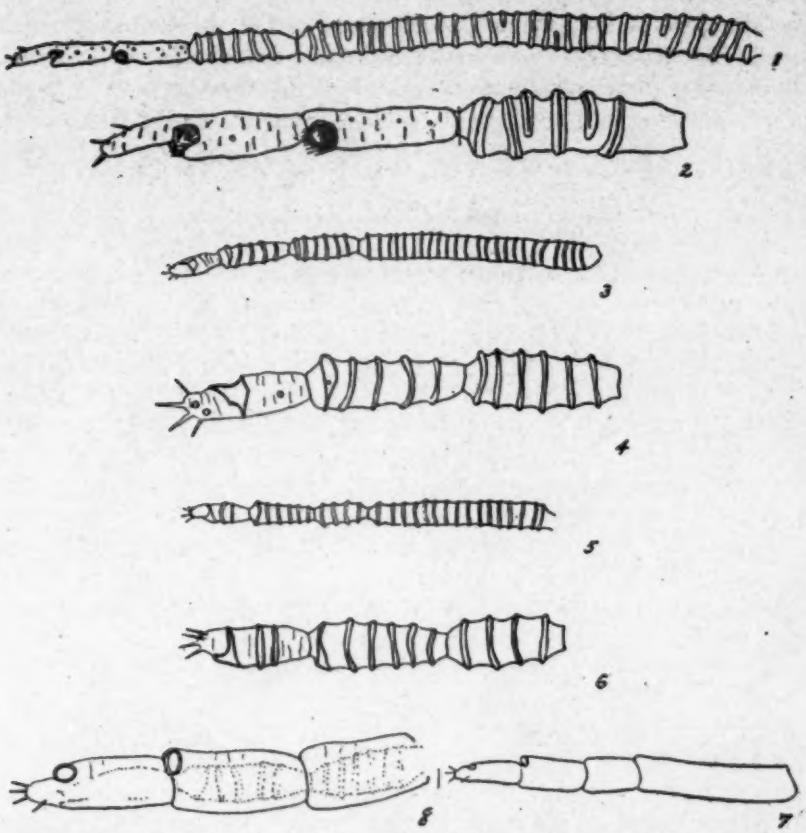



Fig. 3. 1 and 2 *Schizoneura ulmi* of Europe, fundatrigenia, migrant from elm leaf, collected in California; 3 and 4 *S. lanigera*, fundatrigenia, migrant from elm leaf, no. 9–12, winged progenitors of 9–12 sub. 1; 5 and 6 *S. lanigera*, sexuparæ-migrant from apple bark, no. 9–12 sub. 1, cage reared descendants of 9–12; 7 and 8 *S. lanigera*, pupa just before molt; (Figures 1, 3, 5, 7 are drawn to the same scale and figures 2, 4, 6, 8 are drawn to the same scale.)

annular and like the others, or, in many cases, variously modified and spread much like the terminal sensorium of VI. In the apterous forms and in the nymphal stages a circular terminal sensorium exists on both V and VI but these are lost in the winged form with the pupal molt.

That two elm leaf curling species of *Schizoneura* occur in other countries is certainly more than suggested by the figures of "*ulmi*" by Kessler (1878), Buckton (1881), Okajima (1908), Tullgren (1909), and Theobald (1912). The clue as to which one of these migrates to *Ribes* is sufficiently indicated by the figures of *fodiens* by Buckton, Tullgren and Theobald.

That the second elm leaf curling species of other countries is *lanigera*,

the life cycle of *lanigera* in United States is circumstantial evidence strong enough to serve as a working hypothesis and this question will doubtless be settled by European workers in due time.[1]

---

## A BRIEF REPORT ON THE PIOJO BLANCO OF COTTON

By CHARLES H. T. TOWNSEND, *Lima, Peru*

### ARRIVAL AND SPREAD

This scale-insect, technically known as *Hemichionaspis minor*, has developed since 1905 into a serious pest of cotton in the Department of Piura. The species is more or less tropicopolitan and its country of origin is in doubt, but it seems quite certain now that it reached Peru from the humid coast region of Ecuador where it occurs on wild cotton at the present time. It evidently entered the Piura region at the port of Paita on shipments of plants from Guayaquil or Tumbes, and was thence carried in shipments by rail to the towns of Sullana and Piura. At these two places it established itself in the gardens and cotton patches near by, thus gaining a foothold.

It first attracted attention on cotton in the Piura valley near Piura town, in May, 1905, but was not noted as a pest of cotton in the Chira valley until 1907, and reached the upper cotton districts of the Chira around Somate in 1908. It was not noted on cotton in the southern districts of the Piura valley until 1910, having appeared at Santa Clara in February of that year. During 1910 it spread scatteringly southward from Santa Clara to near Sechura, thus completing the invasion of the entire cotton area of Piura Department in the Piura and Chira valleys. It reached the extreme upper cotton districts of the Piura valley, at Solsol, Paccha and Nómala in 1910; and was found by me in November, 1910, heavily infesting old tree-cotton at Macara, Ecuador, and on cotton as far up the Rio Macara as a point above the Hda. Limon Crossing.

The scale has been spread through the cotton districts of the Chira and Piura valleys by two agencies operating in contrary directions. The strong and long-continued winds from the south have carried

---

[1]Since this paper went to press two marked publications from Germany have been received; one written by Dr. Carl Börner (*Kaiserliche Biologische Anstalt für Land- und Forstwirtschaft*, August, 1909) in which he suggests the probable necessity of a host plant other than the apple for the winter egg, stem mother, and the spring generation of the "Blutlaus," and the second by Dr. L. Reh, Hamburg, who, (*Der Praktische Ratgeber im Obst- und Gartenbau*, February 2, 1913, pp. 47–48), reviews both German and American observations on the "Blutlaus" and reinforces Doctor Börner's conclusions on the basis of his own fruitless searches of many years for the winter eggs of this aphid on apple.

it northward up both valleys. The waters of the two rivers flowing south and west, transporting it constantly into the fields during irrigation, have carried it generally southward especially in the Piura valley, and this in direct opposition to the prevailing strong winds. This explains its late invasion of the lower Piura valley.

## Conditions Encountered in Piura, Including Enemies

This insect, like most diaspine coccids, if left undisturbed, is able to breed quite continuously under all the climatic gradations from warm humid to hot arid, provided only that its host-plant remains physiologically active. The cotton plant is active throughout the year in Piura Department, the climate is excessively arid from December to May and with considerable atmospheric humidity from June to November during the nights and forenoons. Practically no rain falls at any time of year. This climate is not duplicated anywhere in the world, and is only approached in a few districts like certain parts of northwestern Mexico, western Australia and perhaps southwestern Africa. The Piura region is much dryer than the central coast region of Peru. It is exceedingly interesting, therefore, from both the economic and biologic standpoints, to note what has taken place with reference to this insect and its enemies under the almost unique climatic conditions in question.

Having gained access to the Piura region, the insect either brought with it or was met there by certain microhymenopterous parasites common to diaspine scales in tropical and subtropical countries and by others especially American, as well as by still other enemies largely native to the country. The parasites and enemies now at work in some force on *Hemichionaspis minor* in Piura Department are as follows:

(1) *Aspidiotiphagus citrinus*—Tropicopolitan to temperate. Found in 1909 in both Piura and Lima. Known to oviposit in the active young of the scale, and thus possibly brought into the Piura region by the host, though more probably generally distributed with other scale insects before the advent of the piojo blanco. Abundant and evenly distributed. Both Piura and Chira valleys.

(2) *Prospaltella peruviana*—Peruvian. Found in 1909 in both Piura and Lima. Not nearly so abundant as the first, and while distributed everywhere it occurs unevenly and in fluctuating numbers. Both Piura and Chira valleys.

(3) *Prospaltella aurantii*—Tropicopolitan to temperate. Not found in Lima, and not in Piura till 1910 after liberations from North America in 1909. Its presence in Piura is therefore perhaps the

result of the importations from North America. Local and uncommon. Piura valley only.

(4) *Aphelinus fuscipennis*—Tropicopolitan to temperate. Found in 1909 in Lima, and in 1910 in Piura but probably existed in latter region before the liberations of 1909. Local and uncommon. Piura valley only.

(5) *Aphelinus quaylei*—Tropicopolitan. Found in 1909 in Lima. Not found in Piura until 1912, after liberations of much material from Lima. As yet recovered in Piura only from *Pseudaonidia* sp., but known from *H. minor* in both Ceylon and Hawaii and quite certainly at work on it in Piura. Locally numerous. Both Piura and Chira valleys.

(6) *Signiphora lutea*—Peruvian. Found in 1909 in both Piura and Lima. Common and rather evenly distributed. Both Chira and Piura valleys.

(7) *Signiphora occidentalis*—California to Barbados and Peru. Found in 1909 in Lima. Not found in Piura till after the 1910 liberations from Lima and the 1911 liberations from Barbados. Fairly numerous but unevenly distributed. Both Chira and Piura valleys.

(8) *Neosigniphora nigra*—Peruvian. Not found in Lima. Found quite abundant in the central Piura valley in 1910. Locally abundant. Piura valley only.

(9) *Arrhenophagus* sp. probably *chionaspidis*—Tropicopolitan to temperate in northern hemisphere. Not found in Lima, nor in Piura till 1912 after Japanese and Barbadoes liberations of 1911, which latter contained the species in abundance. As abundant as Aspidiotiphagus in many places, but not so evenly distributed. Both Chira and Piura valleys.

(10) *Microweisia vel* Gen. Aff. sp.—A very small black coccinellid, evidently native to the Peruvian and Chilean coast region. Very abundant and evenly distributed throughout both valleys.

(11) *Psyllobora* sp.—A pale yellow coccinellid of less than medium size with nine brown spots on each elytron, evidently native to the Peruvian coast region. Locally numerous, especially in the Piura valley, but distributed in both valleys.

(12) *Exochomus* sp.—A pale yellow coccinellid of less than medium size with six brown spots on each elytron, evidently native to the Peruvian coast region. Locally numerous in both valleys.

(13) *Hemisarcoptes malus*—Cosmopolitan mite. Very abundant and evenly distributed in both valleys.

(14) *Gamasidæ* sp.—Locally abundant. Piura valley only.

(15) *Sporotrichum* sp. probably *minimum*—Abundant and evenly distributed in both valleys.

The first nine of the above are microhymenopterous parasites that attack various diaspine scales; the next three are coccinellid beetles and the next two mites, all predaceous on the scale; the last is a white cottony fungus which attacks the scale. All of these fifteen enemies are very active during the more humid months from June to November, but unlike the scale they are unable to continue highly active during the very dry months from December to May. In a humid region like Panama or Ceylon, these enemies would completely dominate *H. minor* throughout the year. As it is in Piura, they practically succeed in dominating it by the end of the season of humid nights and mornings, about October or November and sometimes locally much earlier, but a certain small proportion of the young of the scale always escapes their attacks. The few young that escape, being relieved from the activity of their enemies, multiply in ever-increasing ratio during the extremely dry season from December to May until the plague assumes nearly the same proportions as the year before.

Indications suggest the possibility that the enemies of the scale may be slowly gaining on it from year to year in Piura. In 1910 it was difficult to find much living scale in November; in 1911 it was noted as very largely dead in October and locally so in September; while in 1912 it was found dead over certain considerable areas as early as July and August, and locally so even in June. Reliance should not, however, be placed on these indications, since a wide allowance must always be made for fluctuations due to factors beyond control, such as variations in climatic conditions and in activity of host-plant due to irregularity of water-supply.

## Importation, Liberation and Distribution of Enemies

The following liberations of material imported into the Piura region from the outside, for the purpose of establishing enemies of *H. minor* not already occurring there, must be recorded. The scales used as vehicles were all diaspine, and care was exercised to prevent the escape of any species of scale not already present in the region.

United States—Three shipments of *Diaspis pentagona* from Washington, D. C. First abandoned in Piura town in August, 1909. Second liberated at Samán in November and December, 1909, some 700 microhymenopterous parasites by actual count being turned loose in the field as fast as they issued. Third liberated from Paita to Samán in February and March, 1910.

Lima—Two shipments of five boxes each, containing diaspine scales on Eriobotrya, Dracæna, Magnolia, Opuntia and Rosa. First liberated

at Chapairá in June, 1910. Second liberated at Catacaos in August, 1910.

Japan—Three shipments of the coccinellid beetle, *Chilocorus similis*, the first using *Hemichionaspis aspidistræ* and the other two *Diaspis pentagona*; and one shipment of *Diaspis pentagona* containing *Azotus* n. sp. near *capensis* and what was probably *Arrhenophagus chionaspidis*. The first coccinellid shipment, containing about 100 living beetles, was liberated at Catacaos in November, 1910; second, containing only three or four living beetles on arrival, was liberated in March, 1911, at Coscomba; third arrived with all beetles dead in August, 1911, and was put out at Coscomba. The parasite shipment was liberated at Coscomba in March, 1911.

Barbados—One shipment of *H. minor*, containing many Arrhenophagus and other parasites. Liberated at Catacaos in May, 1911.

The thanks of the Peruvian government are due to The Honorable Commissioner of Agriculture for the West Indies, for the Barbados shipment; to Mr. S. I. Kuwana, Imperial Entomologist of Japan, for the Japanese shipments; to Dr. L. O. Howard, Chief of the United States Bureau of Entomology, for the Washington shipments; and to Prof. Ch. Deneumostier, Director of the Escuela Nacional de Agricultura y Veterinaria, for the Lima shipments.

These shipments, though received at great disadvantage due to lack of proper facilities, have undoubtedly borne important fruit. Various species additional to those enumerated and quite certainly contained in them have not yet been recovered in Piura, but may nevertheless be found established there in the future, as the result of these liberations.

Thanks are also due to Mr. E. E. Green, Government Entomologist of Ceylon; to Mr. Charles P. Lounsbury, Government Entomologist of South Africa; to Mr. H. A. Ballou, Government Entomologist of Barbados; to Mr. F. W. Urich, Government Entomologist of Trinidad; and to Mr. E. M. Ehrhorn, Government Entomologist of Hawaii; all of whom sent valuable material of Hemichionaspis to assist in the preliminary search for suitable parasites; and to Mr. E. K. Carnes, Superintendent of the California State Insectary, who sent material from California.

During 1910 and 1911 one hundred and more different shipments of *H. minor* containing parasites were made between various points in the infested region of Piura, for the purpose of distributing the different species of parasites as evenly as possible through both the Chira and Piura valleys. Important results are already visible from this work, and further results from these shipments will no doubt appear as time goes on.

Of the fifteen enemies enumerated as now at work on the piojo blanco in Piura, probably the most effective at present is the small black coccinellid beetle, Microweisia (?) sp. Next to it in present effectiveness evidently come Aspidiotiphagus and Arrhenophagus.

## Enemy Work for the Future

It is desirable that further enemies be imported, especially with the view of finding if possible one or more kinds that will continue high activity through the dry season in Piura. The most promising regions in which to search for such enemies are Sonora, Sinaloa and especially the Gulf coast of Lower California; also probably parts of western Australia and western Africa. Arid region coccinellids should be especially searched for and tried. The most promising restricted district that can at present be suggested for such search is on the Gulf coast of Lower California near the middle of the peninsula, opposite the Sonoran port of Guaymas and between the two settlements of Santa Gertrudis and Santa Rosalia. Of the whole peninsular of Lower California, noted as a land of drought and desert, this district receives the least rainfall and has the highest temperatures, with the minimum of atmospheric humidity during the year. Its coccinellids should therefore be able to continue activity through the Piura dry season. The dryest and hottest regions of western Australia should also be searched for scale-feeding coccinellids. All importations from excessively arid regions should be so timed as to arrive in Piura in December and January. This applies regardless of whether they come from points in the northern or southern hemisphere.

Present experience does not warrant further introductions into Piura of enemies from humid regions, except perhaps in the case of the coccidivorous fungi that have proved so successful against scale-insects in Florida. These fungi would probably flourish in Piura during the humid months, and might very materially decrease the number of the young scales that escape the present enemies. All importations from regions more humid than Piura should be so timed as to arrive in Piura during June and July.

Artificial breeding in the insectary of the three coccinellids now attacking the scale in Piura, *Microweisia* (?) sp., *Psyllobora* sp., and *Exochomus* sp., should be extensively pursued, especially with the first, during the months of August, September and October, for the purpose of producing as large quantities as possible for distribution, and such breeding should be continued through the dry season in the insectary by artificially supplying the requisite degree of atmospheric humidity. Distributions of these coccinellids should be made continually over the infested region during November and through

the dry season. If this plan be thoroughly carried out, it is quite probable that the relatively few young of the scale that now escape at the end of the humid season may be practically wiped out so as to prevent the increase that has heretofore taken place during the dry months.

The breeding work with native coccinellids should include at least four plans of handling. One lot should be gathered during the first week of August in the fields or taken from lots bred in the insectary, after about two months of high activity of the species, and subjected continuously in the insectary to artificial hot arid conditions for two months through August and September and the first week of October. This lot should then be distributed evenly through the infested districts during the second week of October, the natural relative humidity at this season being sufficient to awaken them immediately to activity. Under these conditions they should continue active feeding and breeding in the open well into the dry season, being incited thereto by their forced period of inactivity.

A second lot should be gathered and carried like the preceding till the middle of October, and then, instead of being put at once in the field, they should be subjected to high humidity in the insectary —higher than exists at the same season in the open, and bred in as great numbers as possible for weekly distribution through November and the succeeding dry months as long as they will last.

A third lot should be gathered in the field at the beginning of the humid season, the last week in May or the first week in June, and subjected continuously like the preceding two lots to artificial hot arid conditions until about the last of October, when they should be partly liberated in the fields and partly kept for breeding purposes in the insectary. These, having experienced a prolonged season of inactivity, should continue active longer into the dry season in the open than the first lot, providing that their vitality has not been lessened by their experience.

A fourth lot should be reared continuously in the insectary from June or gathered from the fields in August, and carried through in the insectary from September to May or as long as they will last, making distributions from the progeny as often as possible.

If this breeding of native coccinellids does not give the desired result, the Japanese *Chilocorus similis* and the Florida coccidivorous fungi should be tried in the fields during the humid season, carrying them both artificially through the ensuing dry season in the insectary and putting them out again in the field the humid season following. Should all of these measures, combined with such cultural control measures as can be devised, fail to wipe out the plague, then search

must be made for a dry-season enemy in Mexico or Australia, or both. If the native coccinellids can not be handled as above outlined, it is certain that the Japanese species can not be so handled. But coccinellids must certainly exist in Lower California and western Australia that can be so handled.

## Cultural Control Measures

The investigations so far made in Piura indicate three important cultural measures that may be employed to advantage by the individual planter for the control of the piojo blanco on cotton. They may be outlined as follows:

(1) Cut out all infested plants other than cotton, such as castor bean, willow, melon, pigeon pea, beans, weeds, etc., since the cotton is continually reinfested from such plants. The scale appears to flourish at times on these plants when it has died out on the cotton in the vicinity, and thus such plants constitute a reservoir of infestation. Such reinfestation is especially liable to take place at the beginning of the dry season. Therefore such plants should be cut out during November and December and burned.

(2) Apply all the water that the cotton plants can stand without interfering with the proper ripening of the bolls and the gathering of the crop. The more water that can be applied to the fields the better, especially during the dry season. This has two results: (*a*) It stimulates the growth of the cotton plant so that it can better resist the attack of the scale; and (*b*) it supplies the necessary degree of atmospheric humidity in the fields requisite to maintain the parasites and enemies in active and effective condition. In carrying out this measure, it must be borne in mind that the cotton plant yields best if water is withheld during the maturing of the bolls, even to the point of practically drying out the soil; that application of water must be regulated to the physical constitution of the soil treated; and that a large part of the crop comes during the first half or more of the dry season, at just the time of year when it is particularly desirable to increase the humidity in the fields for the purpose of fostering the activity of the enemies of the scale. Again water is often not available when wanted, especially in the Piura valley during the first part of the dry season. All these points must be taken into consideration for operations in each district where practicable to employ this measure, and its advantages and disadvantages weighed against each other in accord with the conditions which govern that district until the proper balance of operation is struck. Careful laboratory and field station experiments are especially needed to determine these oper-

ation balances for the various districts, which differ largely in soil conditions and water facilities; as well as for different varieties of cotton, which differ as to the cropping-season possibilities.

(3) Cut back the cotton plants immediately after the gathering of the Christmas crop of the second or third year, or as soon as it is found that the preceding measures are not holding the scale in check sufficiently under the prevailing conditions to insure an average crop; when cutting back is no longer practicable, on account of age of plants, then replant from seed. The earlier the cutting back can be done at the beginning of the dry season, the more complete will be the control of the scale. The cut stalks should be burned if the cutting is done in the dry season, but if it is done at any time between June and October they should be simply piled up and left undisturbed for a month at least. November cuttings should be burned. These recommendations are made for the purpose of saving the valuable parasites and other enemies that abound on and in the scale from June to October, and which should not be destroyed. In carrying out this measure, it has to be borne in mind that some varieties of cotton can be cut back to advantage once a year, others every two years, and the native tree-cotton or pais variety not oftener than once in three years; and that certain districts are adapted to certain varieties and not to others, on account of peculiarities of soil and water-supply. Among the varieties adapted to the conditions of a particular district, other conditions being equal, that variety should be selected which can be oftenest cut back with advantage. Here again field station experiments are necessary to determine the most advantageous operative details.

## Estimated Capacity for Damage in Piura

The area infested by the piojo blanco comprises the whole cotton region of Piura Department in the Chira and Piura valleys. A conservative estimate of the acreage in cotton in these two valleys would exceed 12,000 hectares or 30,000 acres. The product of this region equals ordinarily about 20 per cent of the whole cotton crop of Peru. As the native tree-cotton is the variety most largely cultivated and brings the highest price, the value of the Piura crop is equal to about £350,000 or nearly 25 per cent of the value of Peru's total cotton crop. The Piura crop should equal, on the above acreage, an annual value of at least half a million pounds sterling. The piojo blanco, if left to itself, will diminish the value of the Piura crop by at least 40 per cent. Its normal possibilities for annual damage in Piura are therefore in the neighborhood of £200,000.

### A Piojo Blanco Quarantine

Peru needs to guard against the spread of this insect southward from Piura through the other cotton districts of her coast region. All the ports of the Peruvian coast south of Sechura should exercise a rigid quarantine against all the ports from Sechura to Panama, both inclusive, so far as plant importations are concerned. The piojo blanco exists in practically the whole west coast region from Panama south to Sechura, and infests a very great variety of plants. It may therefore be very easily brought to the uninfested region south of Sechura on almost any plant shipped from ports in the infested region. All plants entering Peruvian ports to the south of Sechura, arriving on vessels of whatsoever description from the north, should be subjected to the most severe scrutiny by competent persons, and if any scale of any kind is found on them, such plants should be completely destroyed. If they are merely scrubbed with insecticide and allowed to enter, the chances are ninety-nine to one that some of the microscopic young of the scale will escape the treatment and establish the plague at the port entered, whence it will later spread to the surrounding districts. The possibility of the piojo blanco gaining access to the cotton districts of the central coast region of Peru constitutes a most serious menace to the whole Peruvian cotton crop. While it is quite certain that the insect could not prove so injurious in the central coast region of Peru as it has in the Piura region, owing to the much greater atmospheric humidity prevailing in the former which would keep its enemies active during a greater part of the year, nevertheless its damage would quite certainly reach at least 20 per cent in any part of that region. It thus constitutes an impending menace, against which it behooves the Peruvian Government to guard to the limits of its ability.

---

## A SUCCESSFUL TRAP FOR COCKROACHES

By F. L. Washburn, *Minnesota*

Mr. S. A. Graham of this Division has devised a simple trap for catching cockroaches, which works most successfully.

We have personally tried various contrivances on the market and others of our own devising, but find Mr. Graham's trap far better than anything we have met with. It consists of a flat-bottomed water flask, as shown in the accompanying drawing, in the mouth of which is introduced a paper cone (see illustration). This cone is held in place with a little vaseline smeared around the inside of the neck of the flask. The opening at the smaller end of the cone is $\frac{3}{8}$ of an inch in

diameter. It will be noted that a similar cone is placed in position within the larger one, the diameter of the small hole in the inner cone being the same as the smaller opening of the large cone. Both of these openings should be large enough for roaches to pass through easily. One side of the inner cone is glued to the outer cone.

In setting a trap a little banana is smeared around the inside of the cone as an additional attraction to the insects. A number of human hairs were glued, in some of our trials, to the inner cone at the smaller end (see illustration), but repeated trials indicate that these are unnecessary and add to the complexity of the otherwise simple trap.

The following baits were tried:

1. Milk—this worked very well in the dairy building, but gave poor results in other buildings.
2. Liquid chocolate gave poor results.
3. Banana peel; by far the most attractive, giving the best results of any baits tried.

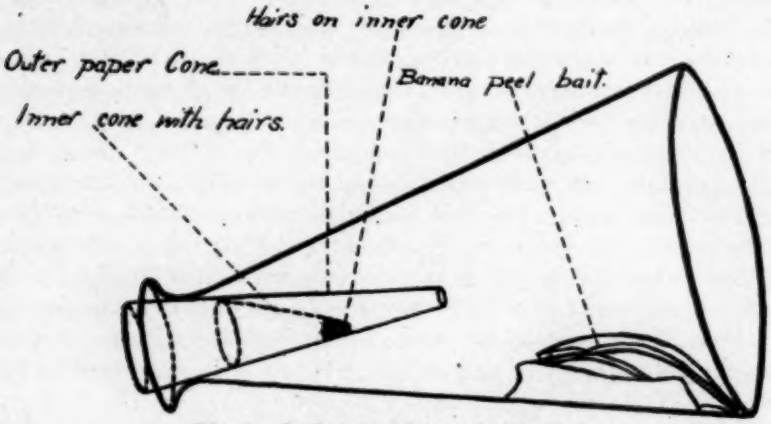



Fig. 4. Graham roach trap (original).

We took occasion to compare this simple trap, which we propose to call the "Graham Cockroach Trap" with the Hodge Fly Trap, which frequently catches roaches. The Graham Trap is superior to this for many reasons.

In the first place the Hodge Fly Trap has the bait outside of the actual trap, that is in the bait pan below the cone and its opening, so that a roach might crawl back (not seeking the light above as flies do) outside of the pan and make its escape; whereas, in a Graham Trap the bait is inside and the roach has to enter the trap before feeding. It is somewhat difficult for roaches to escape from the Graham Trap when once inside, which is clearly evident from observing its construction.

Very young roaches can pass through the wire mesh of the Hodge Fly Trap.

The statement is made above that the hairs appeared to be unnecessary. We found by observation that when the Graham Trap is placed in a secluded part of the room frequented by roaches, where it is not likely to be disturbed, there is little or no effort on the part of the insects to escape and the trap can be left unattended for possibly several days; on the other hand, if the trap was placed where light reached it in the morning and there was more or less activity and noise near it, the insects escaped under those conditions and the hairs made it somewhat more difficult for them to get out. Very few adult roaches are caught in the day time, but nymphs of all sizes enter the trap, apparently at all hours of the day.

We append some of the catches, indicating what the Graham Trap accomplished:

| | | | | |
|---|---|---|---|---|
| March | 22 | In 2 hours | 30 | Nymphs captured in Graham Trap. |
| " | 24 | " 5 " | 5 | Adults and 16 young. |
| " | 24–25 | | 25 | " " 15 " |
| " | 25 | " day time | 5 | " " 17 Nymphs—different stages. |
| April | 1 | | 19 | " " 5 " |
| In another Graham Trap same day | | | 40 | Adults and 12 Nymphs |
| Under Sink | | | 10 | " " 1 "Silver Fish" |
| The last three traps were set over night | | | | |
| April | 14 | | 14 | " " 44 Nymphs |
| " | 10 | | 5 | " " 54 " |

It occurred to the writer that, in view of the lack of success with many traps and the very marked success with the Graham Trap, the above was worthy of record. That the Hodge Fly Trap is useful in this connection, however, is evidenced by observations on the part of Mr. Williamson of this Division, upon two traps, baited with milk which was frequently renewed, placed in the kitchen of a steam-heated flat. The results are shown in the following table:

| Trap I 1912 | | Trap II 1912 | |
|---|---|---|---|
| Nov. | 4–6 ..... 28 | Nov. | 15–17 ..... 12 |
| " | 6–8 ..... 30 | " | 17–19 ..... 12 |
| " | 8–10 ..... 25 | " | 19–26 ..... 17 |
| " | 10–12 ..... 26 | " | 26–29 ..... 14 |
| " | 12–14 ..... 19 | " | 29–Dec. 4 ..... 6 |
| " | 14–17 ..... 20 | Dec. | 4–5 ..... 16 |
| " | 17–18 ..... 11 | | |
| " | 18–19 ..... 11 | Total 20 days ..... | 77 |
| " | 19–26 ..... 26 | | |
| " | 26–29 ..... 9 | | |
| Total 25 days ..... | 205 | | |

# Scientific Notes

**An Acrobatic Fly.** While collecting in Hocking County, Ohio, during the summer of 1911, the writer met with an interesting species of fly. In carefully scrutinizing the sandstone wall near the bottom of a gorge, he was surprised to observe a number of small insects, strung out in a row apparently floating in midair. A closer inspection afforded a novel sight. Thirteen minute flies were seen arranged at intervals along a long spider's thread which extended from one rock prominence to another. Each insect was hanging by the anterior pair of legs and careful inspection with the magnifier showed that they were using the terminal claws to grasp the fine thread. There they hung quite undisturbed by the swaying of the delicate line.

Upon lightly touching one with a small twig it would fly away a short distance, 6 to 10 inches, then begin to hover in the vicinity until it found the thread again. With one exception, each of the thirteen flies succeeded in regaining the thread which it would grasp much in the manner of a horizontal bar performer, its body swaying to and fro after the impact.

This interesting colony was observed frequently after its discovery. The number of insects present was different each time an observation was made, though there were never less than five or six. Whether the insects left at intervals in search of food and returned was a matter quite impossible to determine. There were very few long or short independent spider threads present in the vicinity and of those in use the longer invariably had the larger number of flies. It seemed to the writer probable that the insects did find their way back to their peculiar perch.

Specimens of the midges taken from the spiders thread have been found to belong to different genera. Dr. E. P. Felt has kindly examined them and refers them to the genera Microcerata and Bremia.

B. W. Wells.

**A Probable Parasite of Scapteriscus didactylus in Cuba.** Having received several inquiries about this insect from Messrs. Van Dine, Tower, Crossman, Jones and Hooker, entomologists of Porto Rico, I have been waiting for an opportunity to find out for them something about this insect in Cuba with a special watch for a parasite, for the situation stands thus: *Scapteriscus didactylus* Latr. known in Porto Rico as "changa" is quite a pest there, it exists in Cuba but is rare, although we have similar climatic conditions to those of Porto Rico, and its principal plant food, which is tobacco, is cultivated on a large scale. All this induces us to believe that here must exist a natural enemy that controls this insect.

Through Mr. G. N. Wolcott of the Bureau of Entomology, who at the time was doing special work here on tobacco insects and who went to San Juan y Martinez in the tobacco section of Pinar del Rio Province, we were able to find that *Scapteriscus* was known there and called "berraquito de la tierra" (little ground hog). With this information at hand I took advantage of a trip made to that section on account of a serious pest of wireworms on tobacco, being accompanied by Mr. Wolcott, and we found that what the people there called "berraquito de la tierra" was really the "changa" of Porto Rico or *Scapteriscus didactylus* Latr., and that the fire ant, *Solenopsis geminata* Fab., and the common red ant, *Pheidole megacephala* Fab., were their most dreaded enemies in high and dry land. To the attacks of these ants we partly attributed the fact that *Scapteriscus* has not proved a serious pest.

On a second trip made to San Juan y Martinez I paid attention to this matter of the "berraquito de la tierra." I had specimens brought to me, collected in high land where ants were very abundant, but evidently they had evaded them. Then I

decided to make another excursion to the place known as Galafre where we had found a number of specimens before. On November 30, 1912, while digging for "berraquitos de la tierra" and after collecting a few specimens, we found in the bottom of one of the borrows a cocoon of a hymenopterous insect that appeared to be a parasite, for attached to the outer threads of the cocoon could be seen the mandibles and the fore legs of a *Scapteriscus*. The pupa was still undeveloped but seemed to be that of a Myzinida. More cocoons were found and also a full grown larva spinning its cocoon.

Several cocoons were brought to the laboratory and at this date, April 7, 1913, were opened: three contained dead pupæ, and the other two much shrunken though still living larvæ. The cocoons were found in the bottom of what seemed to be *Scapteriscus* borrows, at a depth of from one to two feet, in a low and moist clay soil, near a brook; they are of a brown color and have two coverings, the one next to the insect is silky and hard, of elongated pear shape, the outer covering is very thin and loose. They measure about 1.6 cm. in length by .5 cm. in its broadest part.

PATRICIO CARDIN,
*Entomologist of the Agric. Exp. Station, Santiago de las Vegas, Cuba.*

**Gouty Pine Midge** (*Itonida inopis* O. S.). Observations of last year (Econ. Ent. Journ. 5: 368) and those of the present season show that under certain conditions this species may be of some economic importance, even though its host plant, the scrub pine, *Pinus rigida*, is not one of the most valuable trees. The latter part of May, 1912, the larvæ of this midge were very abundant at Karner, midway between Albany and Schenectady, N. Y., and similar conditions prevailed this season the last of April, the larvæ emerging with the appearance of several days of warm weather. Observations at this latter time show that a very large percentage, possibly half of the shoots were affected and, in some instances, 40 or 50 larvæ or cocoons were to be observed upon individual shoots. The swollen, injured area ranged in length from three to seven inches, the infestation producing an approximate doubling in the diameter of the twig and presumably interferes with the movement of the sap. One small scrub pine some six feet in height had nearly every shoot affected and it was estimated that over 1,000 larvæ or cocoons were to be found upon this tree, the vitality of which was much reduced, as evidenced by the short, pale needles. The injury by the preceding brood, that is larvæ hatching from eggs in 1911, showed as swollen, scarred pitchy areas. The growth beyond such points was apt to be less vigorous, and it appears probable that in some instances at least, this midge may be an important factor in reducing the vigor of young scrub pines, especially as it appears to be generally distributed and locally abundant. The brilliant orange, conspicuously tubercled larvæ issue so early in the season that they would ordinarily escape attention by most collectors, and this appears to account for the insect having been overlooked for so many years.

E. P. FELT.

**Reorganization of the Gipsy Moth Work of the Bureau of Entomology.**—During the past few months several changes have been made in the gipsy moth work in New England, carried on by the Bureau of Entomology, United States Department of Agriculture. Heretofore the work has been conducted along two separate lines, viz.: field work to prevent the spread of the gipsy and brown-tail moths, and laboratory work, which included the introduction of parasites and predatory enemies of these insects. There has been a reorganization and Mr. A. F. Burgess, who has been connected with the experimental work a number of years, has been placed in charge of the entire project. He will look after the administrative part of the work, and also have general supervision of the experimental work which will be carried on as heretofore.

Mr. D. M. Rogers will have charge of the inspection and quarantine work. Since the Federal Horticultural Board placed a quarantine on the region in New England infested by the gipsy and brown-tail moths, it has been necessary to devise and carry out a careful system of inspection to prevent the dispersion of these species on lumber, forest products, nursery stock, etc. The inspection of nursery stock is being carried on in coöperation with the inspectors in the states concerned.

The scouting work to determine the quarantine line, and also the scouting and control work to prevent the spread of the gipsy moth, has been placed in charge of Mr. L. H. Worthley. During the winter particular attention has been paid to the infestations along the northern and western borders of the outside infested territory and a large force of men has been employed to stamp out incipient infestations in this region and to examine the territory outside the border not known to be infested.

A new line of work has been taken up during the winter, as a result of experimental and field observation work, on the relation of different food plants to the gipsy moth. After consultation with the United States Forest Service an arrangement was made whereby coöperative work will be attempted, and a series of sylvicultural experiments have been planned and are being conducted by Mr. G. E. Clement in order to determine the relation of gipsy moth injury to the sylvicultural condition of the trees in areas where this insect is prevalent.

The parasite work will be continued along the same general lines, as heretofore, with special work to determine the increase and spread of the beneficial species that have been introduced from foreign lands. A long series of experiments will be continued to determine the preference of gipsy moth caterpillars for different food plants and this information will be supplemented by the work of a number of field observers. In addition, studies will be made during the year to determine definitely the increase or decrease of the species in areas which have been specially selected for this purpose. These areas are well scattered over the entire infested territory and the tree growth which is found throughout the region is well represented in them. As a result of these experiments it is hoped that much data may be secured which will have an important bearing on the susceptibility of different trees and shrubs to gipsy moth attack, as this information is of utmost importance in determining the best methods of thinning woodland.

An investigation on the "wilt" disease is being carried on in coöperation with the Bussey Institution, Harvard University. The technical aspects of this work are being directed by Dr. W. M. Wheeler of that Institution, and Mr. R. W. Glaser, who has made a special study of the organism which is responsible for the "wilt" disease, is carrying on a large number of investigations.

The insects which attack trees that are defoliated or weakened by the gipsy moth are being given special study, particularly those species which attack oak. This work is being carried on coöperatively with the Branch of Forest Insect Investigations of the Bureau of Entomology, and Dr. A. D. Hopkins, who has charge of these investigations, is directing the work on this project. An extensive series of experiments is being carried on to determine the methods by which the gipsy moth is spread. Special attention is being paid to the spread of young caterpillars by wind, and also the relation of velocity and temperature to wind spread. An effort is being made to determine how far small caterpillars can be carried in this way. These experiments are of vital importance as they have a definite bearing on the kind and amount of hand work which should be carried on in the towns outside the known infested area.

The Boston office, which has, for a number of years, been located at 6 Beacon Street, was moved May 5 to the Carney Building, 43 Tremont Street, and communications by mail should be sent in the future to that address.

JOURNAL OF ECONOMIC ENTOMOLOGY
OFFICIAL ORGAN AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

JUNE, 1913

The editors will thankfully receive news items and other matter likely to be of interest to subscribers. Papers will be published, so far as possible, in the order of reception. All extended contributions, at least, should be in the hands of the editor the first of the month preceding publication. Contributors are requested to supply electrotypes for the larger illustrations so far as possible. The receipt of all papers will be acknowledged.—Eds.

The campaign against the house fly is being vigorously pushed. New fly traps have been devised in the last few months. In this issue a new cockroach trap is described. These efforts are all praiseworthy, though they are defective in that they fail to go to the root of the evil. The entomologically sanitary premises and dwelling is a development for the future. Progress is being made so far as the premises are concerned, though little seems to have been attempted by architects in designing dwellings which shall be moderately pest-proof. A study of household pests shows this is less difficult than the surgically clean operating room of the hospital. It would seem as though a few moderately expensive changes in the construction of our dwellings would aid materially in eliminating the more obnoxious of our household insects.

The appearance of two volumes of the long expected monograph on mosquitos by Dr. Howard and his associates, marks an important epoch in American entomology. The work, noticed elsewhere in this issue, embodies high scientific ideals, is a classic, and is destined to exercise a profound influence on the scientific investigations of the future. Contributions of this general character are potent factors in placing both economic and systematic entomology upon a thoroughly sound, scientific basis. The writer has long been of the opinion that substantial progress in our branch of science will be made largely by investigations continued for a series of years in connection with, and really an extension of the numerous supplemental studies which must be made from season to season in solving immediate practical needs. Every working entomologist should so plan his efforts as to have a reasonable amount of time each year for purely scientific studies, even though their practical bearings may be somewhat remote.

The recently issued Proceedings of the British Columbia Entomological Society shows a most commendable activity, and we take this opportunity of extending the hand of good fellowship to the entomologists of the Northwest. This society, organized in 1901, has been

quiescent for a time and now, through the efforts of a few energetic leaders, is doing excellent work in recording entomological data and awakening an interest in a most practical phase of agriculture, the control of injurious insects. The Proceedings contain many interesting local records from the various districts, beside a number of special papers, efficient quarantine work being given a good share of attention. This organization is fortunate in receiving a moderate amount of aid through ministerial grants, and we trust that this is only the beginning of better things for the future. There are many general as well as local problems and we look to the Northwest for the assistance it should render, confident that the trust is not misplaced.

This issue gives an outline of the reorganization of the gipsy moth work conducted by the Federal authorities. The comprehensive character of this project is highly commendable. The investigations relative to the spread and efficiency of various parasites and the feeding habits of the gipsy moth caterpillar will give data of fundamental importance in determining the most profitable methods for the future. The prevention of the spread of this pest through the shipment of infested materials and the early detection of outlying infestations are of vital importance in the control work of the immediate future. The gipsy moth problem is one of National importance, and states liable to invasion by this pest must look more and more to Federal agencies for protection from such insects which, if left to themselves, would soon become widely established and inflict enormous losses. The gipsy moth work has received the hearty and almost unanimous support from the economic entomologists of America, and the authorities in charge may confidently expect equally gratifying endorsement in the future.

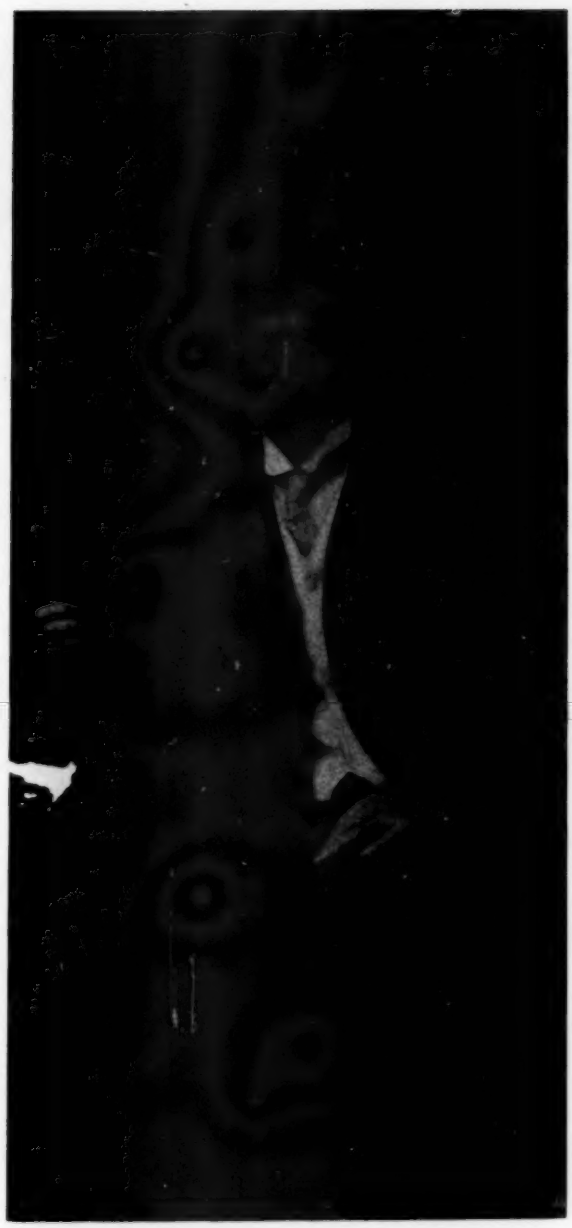
---

## Obituary

### CHARLES WORCESTER HOOKER

Charles Worcester Hooker, entomologist of the Federal Experiment Station, at Mayaguez, Porto Rico, and plant inspector at the Port of Mayaguez for the insular government, died at Mayaguez on February 12, 1913, from an attack of appendicitis.

Doctor Hooker was born at Westhampton, Mass., April 13, 1883; he attended the public schools of that town until June, 1893, when he moved with his parents to Amherst, Mass. He graduated from the Amherst High School in June, 1902, and entered Amherst College the following fall, graduating in 1906. While at Amherst he elected



Charles W. Hooker

the courses given in zoölogy by Drs. John M. Tyler and F. B. Loomis. In September, 1906, he entered the graduate school at the Massachusetts Agricultural College, electing entomology, given by Drs. C. H. and H. T. Fernald, as his major subject, and cryptogamic botany and horticulture as his minor subjects. He acted as a state nursery inspector during the summers of 1907 and 1908. The degree of Ph. D. was conferred upon him in June, 1909, and he at once accepted an appointment with the Bureau of Entomology of the United States Department of Agriculture, working under the direction of Prof. A. L. Quaintance, being detailed to investigate the life histories and habits of cranberry insects in Wisconsin. He spent the balance of the growing season of 1909, and all of the season of 1910, in Wisconsin, with headquarters at Cranmoor. He accomplished a large amount of very valuable work while in Wisconsin and submitted manuscript, now in process of publication by the Bureau, of what appears to be a very complete account of the biologies and habits of the more important cranberry insects in that state, including references to very many other species which he found occurring on the plant.

Doctor Hooker was promoted one grade January 1, 1911. That spring he was transferred to the Government field station at Vienna, Va., and assigned to work on the Coccinellidæ with special reference to determining the comparative economic value of the different species, and also to investigate the biologies and habits of the more important species to furnish information for a better understanding of methods which should be employed in their propagation and dissemination to effect the control of noxious species. A good start was made on this work during the year previous to his resignation.

Doctor Hooker was appointed to the position he held at his death, in October, 1911. He returned to the States on leave of absence during the summer of 1912 and was married on July 3, at Amherst, Mass., to Miss Elizabeth R. Wiley. Doctor Hooker's body was brought to Amherst, Mass., and interred in Wildwood Cemetery on February 22.

As a student Doctor Hooker made many friends by his genial ways and quick appreciation of the interests of others. Of his work after leaving Amherst, his chief, Professor Quaintance writes: "He had proved himself to be a very conscientious and faithful worker and inspired the esteem and affection of all who came in contact with him. I regard his untimely death as a very severe loss to the science of Entomology, both economic and in its broader aspects." His loss will long be felt by all those who knew him.

H. T. F.

WRITINGS OF C. W. HOOKER

A New Cecidomyiid on Oak (Ent. News, 19, 1908, No. 8, pp. 349–352, Pl. 1). (H. M. Russell associate author.)

The Periodical Cicada in Massachusetts (Massachusetts Sta. Report, 1908, pt. 2, pp. 200–210).

Fumigation of Cucumbers (Massachusetts Sta. Report, 1909, pt. 1, pp. 227–247).

The Ichneumon Flies of America Belonging to the Tribe Ophionini (Trans. Am. Ent. Soc., 28, 1912, No. 1–2, pp. 176+176a–176c, Pls. 3).

Report of Entomologist (In course of publication).

Report on Cranberry Investigations (Now in course of publication).

A paper to be issued as a bulletin or circular of the Porto Rico Station.

## Reviews

**The Mosquitos of North and Central America and the West Indies,** by L. O. Howard, H. G. Dyar and F. Knab. The Carnegie Institution, Washington, D. C., quarto, Vol. 1, p. i-vi, 1–520; plates 1–14; Vol. 2, p. i–x, plates 1–150. 1912.

A decade of work has come to partial fruition in two volumes of a magnificent monograph—a work highly creditable alike to the authors, the numerous collaborators and the institution standing sponsor for the undertaking.

The first volume, introductory and practical in nature, presents in a condensed form a wonderful amount of information and is a logical introduction to the systematic discussion in the third and fourth volumes. The magnitude of the task has prevented the authors and their collaborators from investigating all phases of the subject, and we find throughout this first volume, excerpts from the writings of various investigators. The authors have given particular attention to the historical development of our knowledge of mosquitos along various lines and great care has been exercised in giving credit to different parties.

The introduction outlines the causes resulting in the recently developed great interest in mosquitos, records briefly the typical regions in which the Culicid fauna was studied and acknowledges the services of many collaborators. The next few pages give a vivid idea of the pestiferous potentialities of mosquitos, and this is followed by a summary of earlier accounts relating to Culicid biology. The structure of the adult is discussed in 59 pages, that of the internal anatomy being from Stephens and Christophers. The consideration of the larva is an excellent morphologic and taxonomic exposition and gives, within a small compass, a good idea of the development of these forms. The behavior of the adults has been carefully studied by the authors, there being detailed observations on the food habits, song, hearing, longevity, hibernation, mating, the superabundance of mosquitos, especially in the northwest and Alaska, and the deposition of eggs.

The importance of a knowledge of mosquito larvæ is fully recognized and we find a succinct though comprehensive account of their habits, food and natural enemies, the latter topic occupying 21 pages of text.

The place of the mosquito as a disease carrier is fully discussed, this topic including detailed accounts of the important disease carriers, namely, the malaria and yellow fever mosquitos, and occupying over 130 pages. There is most suggestive data on the losses caused by malaria and an exceedingly instructive discussion of the decrease and increase of this disease following settlement of the country and the attention or lack of

attention to drainage. There is a very full discussion of yellow fever and the earlier outbreaks of this disease, the yellow fever mosquito in its various relations and practical means of controlling the pests. We find assembled in these pages, much data, historical, sanitary and scientific, which is invaluable and necessary to the successful control of these scourges of mankind. The scope of this study is suggested by such topics as the original home of the yellow fever mosquito, its distribution in America, length of life of the imago, distance of flight, mosquitos biting cadavers, and mosquitos in the courts of law, to mention only a few.

About 90 pages are devoted to antimosquito work, protection from adults, destruction of larvæ, etc. The elimination of breeding places is discussed largely in accounts of work done in various communities, both domestic and foreign. There is an extended and well selected bibliography and a detailed index.

The second volume is composed entirely of plates and their explanations, the latter reduced to a minimum and open to the criticism that no indication of the enlargements is given. A number of these figures have been published in connection with earlier papers by one or more of the authors, though this does not in the least detract from their scientific value. The figures of entire larvæ on plates 42–85 are a noteworthy contribution to the art of scientific illustration. They are accurate, attractive, and yet none too large to show the complex structure of these organisms.

A work of this character can not be too highly commended, though costly in men, time and money. There is urgent need of more such monographic studies, investigations which not only elucidate obscure problems and lay the foundation for successful practical work, but which also serve as a vigorous stimulus for similar studies in other lines and thus, indirectly at least, may have a very far-reaching effect. The authors are to be congratulated upon having produced such a meritorious work, one which will be the basis for all subsequent investigations in this very important group.

The complete work, consisting of four volumes, may be obtained through the Carnegie Institution of Washington (16 Twelfth St.), for $10.00, the unpublished volumes to be forwarded as soon as issued.

---

## Current Notes

**Conducted by the Associate Editor**

The legislature of Minnesota has passed a Foul Brood Law.

Prof. C. F. Baker has recently been appointed professor of agronomy in the University of the Philippines.

Prof. H. A. Morgan, director of the station, has been appointed dean of the Tennessee College of Agriculture.

Mr. David Sharp of England and Dr. J. H. Fabre of France, have been elected honorary members of the Entomological Society of America.

The Pacific Slope Association of Economic Entomologists, held its fourth annual meeting at the University of California, Berkeley, April 10–12.

Dr. E. P. Sandsten has been appointed professor of horticulture in the Alabama College, and horticulturist of the Station, *vice* P. F. Williams, deceased.

Recent provision has been made for increased laboratory facilities for the Department of Entomology of the Nova Scotia Agricultural College at Truro.

Prof. S. J. Hunter of the University of Kansas was elected a member of the Board of Education of the City of Lawrence, at the recent election, April 1.

N. E. Shaw, chief nursery inspector of Ohio, held a public demonstration of pruning and spraying at the orchard of D. J. Cable, German Township, April 9–10.

George A. Smith, government agricultural demonstration agent, has been appointed inspector of nurseries and orchards for the Beaumont district, Texas.

Prof. R. W. Doane of the Department of Entomology and Bionomics in Leland Stanford Jr. University is investigating certain pests of the cocoanut trees of Samoa at the request of some of the growers.

The department of entomology, University of Nebraska, will soon be housed in a new building that will cost $85,000, and which will also contain the departments of horticulture and of agricultural botany.

Dr. Henry T. Fernald, professor of entomology, Massachusetts Agricultural College, sailed April 28 for Europe where he will visit a number of museums to examine type material, returning to America about the middle of September.

Paul Smith Welch, A. M., fellow in zoölogy, University of Illinois, will give instruction in entomology during the summer at the Biological Station of the University of Michigan, Cheboygan County, Michigan.

The honorary degree of D. Sc was conferred upon Prof. E. B. Poulton, on the occasion of the installation of the Duke of Northumberland as Chancellor of Durham University.

Dr. C. D. Jarvis, horticulturist of the Storrs Station in Connecticut, has severed his connection with the station and will have charge of the agricultural extension work of the state conducted jointly by the United States Department of Agriculture and the Connecticut Agricultural College.

A school for beekeepers was held at the Massachusetts Agricultural College, May 28 to June 11, under the direction of Dr. Burton N. Gates. Doctor Gates attended the annual meeting of the Connecticut Beekeeper's Association at Hartford, Conn., April 19.

A State Crop Pest Commission has recently been established in West Virginia with an appropriation of $10,000 per annum. This commission is composed of the director of the station, the commissioner of agriculture, the president of the State Horticultural Society and the station entomologist is *ex officio* State Entomologist.

Announcement is made of a beekeeper's convention to be held at the Agricultural College, Amherst, Mass., June 11 and 12. The program includes papers by Dr. B. N. Gates, E. R. Root, Morley Pettit, Ontario, Can.; Dr. Chas. G. Schamu, Syracuse, N. Y., and many New England beekeepers and apiary inspectors.

Mr. James F. Zimmer, formerly in charge of the insecticide testing laboratory of the Bureau of Entomology at Vienna, Va. has resigned in order to accept a position as assistant state leader in farm management at Manistee, Mich. His duties will be to assist the fruit growers and farmers along the eastern shore of Lake Michigan.

Mr. Donald J. Caffrey, who for three years has been assistant to the State Entomologist of Connecticut, in charge of the field work against the gypsy and brown-tail moth, resigned May 15 to accept a position in the Bureau of Entomology, in connection with cereal and forage insect investigations. He has been assigned to work on the range caterpillar in New Mexico.

*Science* is authority for the statement that "The teachers of the Norman School at Avignon, of which M. J. H. Fabre, the entomologist, was a pupil, are taking steps to erect a monument in his honor. The council of Vaucluse has voted 1,500 francs to the fund."

Mr. S. S. Crossman, entomologist of the Board of Commissioners of Agriculture of Porto Rico, has recently moved his residence from San Juan to Aibonito. He is engaged in studying the tobacco insects of Porto Rico, the two worst ones being the mole cricket, *Scapteriscus didactylus* and a species of flea beetle.

According to *Science*, J. M. Aldrich, professor of Zoölogy and Entomology at the University of Idaho, has been forced to retire after twenty years' service. The details of this action are explained by Professor Vernon L. Kellogg in *Science* for May 16, page 751. Professor Aldrich, who is an eminent dipterist, has accepted a position with the Bureau of Entomology at Washington.

Michigan has recently enacted a new Foul Brood Law with an annual appropriation of $1,500, which should provide for effective work. Though the administration of this measure is under the State Board of Agriculture, this board has placed it in direct charge of Prof. R. H. Pettit, entomologist of the Agricultural Experiment Station, who has appointed Mr. McMillen, of Guelph, Ontario, as inspector.

Dr. M. C. Tanquary, instructor in entomology at the Kansas State Agricultural College and assistant entomologist in the Kansas State Experiment Station, has been granted a leave of absence and will accompany the Crocker Land Expedition, which is to leave New York City July 2 for the Far North, under the auspices of the American Museum of Natural History of New York. It is also supported by the American Geographical Society, the University of Illinois, Yale University, Bowdoin College, New York Academy of Science, and several individuals, including Colonel Roosevelt and Admiral Perry. Doctor Tanquary will have charge of the zoölogical and botanical research work.

The recent session of the Montana Legislature enacted a law creating the Montana State Board of Entomology, whose duty it is to "study the dissemination by insects of diseases among persons and animals, said investigation having for its purpose the eradication and prevention of such diseases." The board is further required to take steps to eradicate and prevent the spread of diseases that may be transmitted by insects and an appropriation of five thousand dollars a year for the next biennium is made. The immediate object in passing the law was to provide for the eradication of the Rocky Mountain spotted fever tick. The membership of the board is *ex officio* and is made up of the secretary of the State Board of Health, chairman; the State Entomologist, secretary, and the State Veterinarian.

According to *Science* Dr. Paul Marchal, chief of the Entomological Station of Paris, Professor in the Agronomical Institute of France, and a member of the French Academy of Sciences, landed in New York May 4. He comes to America for the purpose of studying the organization of the Bureau of Entomology of the Department of Agriculture at Washington and other organizations working in applied entomology and will remain in the United States for two or three months. Dr. Marchal is especially well known to general students of biology and morphology on account of his remarkable researches in polyembryony. In the course of his stay he will visit most parts of the United States.

Congress has furnished the Bureau of Entomology with funds to be used in the eradication of the tick which transmits spotted fever in the Bitter Root Valley in Montana. Doctor H. T. Ricketts demonstrated that the disease is transmitted only

by the tick, *Dermacentor venustus*. Investigations conducted by the Bureau of Entomology in coöperation with the Montana Agricultural College have shown that a comparatively simple and inexpensive plan of eradication of the tick may be put into operation. Coöperation has been arranged with the Montana State Board of Entomology which, under recent action of the legislature, has full authority to prescribe quarantine and other regulations that may be necessary for the work.

---

Federal Horticultural Board. Quarantine notice No. 7 forbids the importation from Europe of all five-leaved pines (*Pinus albicaulis, aristata, ayacahuite, balfouriana, bonapartea, cembra, excelsa, flexilis, koraiensis, lambertiana, mandschurica, monticola, parviflora, pentaphylla, peuce, pygmaea, strobiformis, strobus*) and their horticultural varieties.

The recently issued circular 44 of the office of the secretary of agriculture replaces circular 41, amplifies the classification of plants hitherto given on the permit, changes regulation 3 to correspond with the new form of permit (one permit authorizing importation for the season); regulation 5 is modified to include plant quarantine decision No. 2; regulation 7 is altered by the addition of the term "exporter"; the part of regulation 6 becoming of non effect after July 1 next is omitted and provision made for treatment of infested nursery stock from countries without an official inspection system; regulations 9 and 11 are omitted—these changes all being in the nature of corrections of errors (see circular of information No. 4). Circular of information No. 3 deals with foreign inspection and certification requirements.

---

## NATIONAL COMMITTEE ON ENTOMOLOGICAL NOMENCLATURE

The Second International Congress of Entomology at Oxford during 1912 unanimously passed certain resolutions, creating and directing an International Committee on Nomenclature. Among the duties of this committee are:

1. To enter into communication with the entomological societies of the world with the view of forming national committees on entomological nomenclature.
2. To collect, in coöperation with the national committees, the opinions of entomologists on questions of nomenclature as affecting entomology.
3. To consider what elucidations, extensions, or amendments, if any, are required in the International Code.
4. To confer with the International Commission on zoölogical Nomenclature, and
5. To lay a report before the next Congress of Entomology (in 1915).

It will be noted that this committee is directed to enter into communication with the various entomological societies in order to form national committees on nomenclature. Dr. Karl Jordan, secretary of the International Committee, has performed this service for the European societies, and at his request Mr. Nathan Banks has undertaken similar work for the American societies. Mr. Banks now desires the appointment of two members from the Association of Economic Entomologists to serve on the American National Committee, and I have therefore asked Professor Herbert Osborn, of the University of Ohio, and Dr. A. D. MacGillivray of the University of Illinois to act in this capacity, which they have kindly consented to do.

P. J. PARROTT.

May 22, 1913. *President of the American Association of Economic Entomologists.*

---

Mailed June 16, 1913.